JULY, 1961 / $1

ARMED FORCES Management

PUBLISHED FOR THE MILITARY SERVICES OF THE FREE WORLD

ADP SPECIAL ISSUE *INCLUDING:*

Capt. Svendsen and Navy's Combat Computer . . . 14

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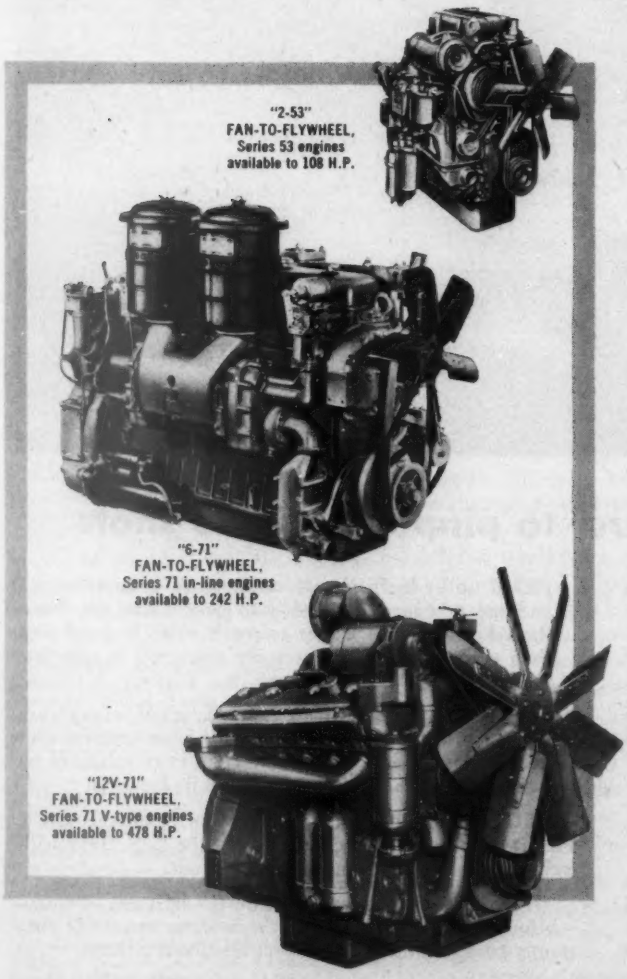

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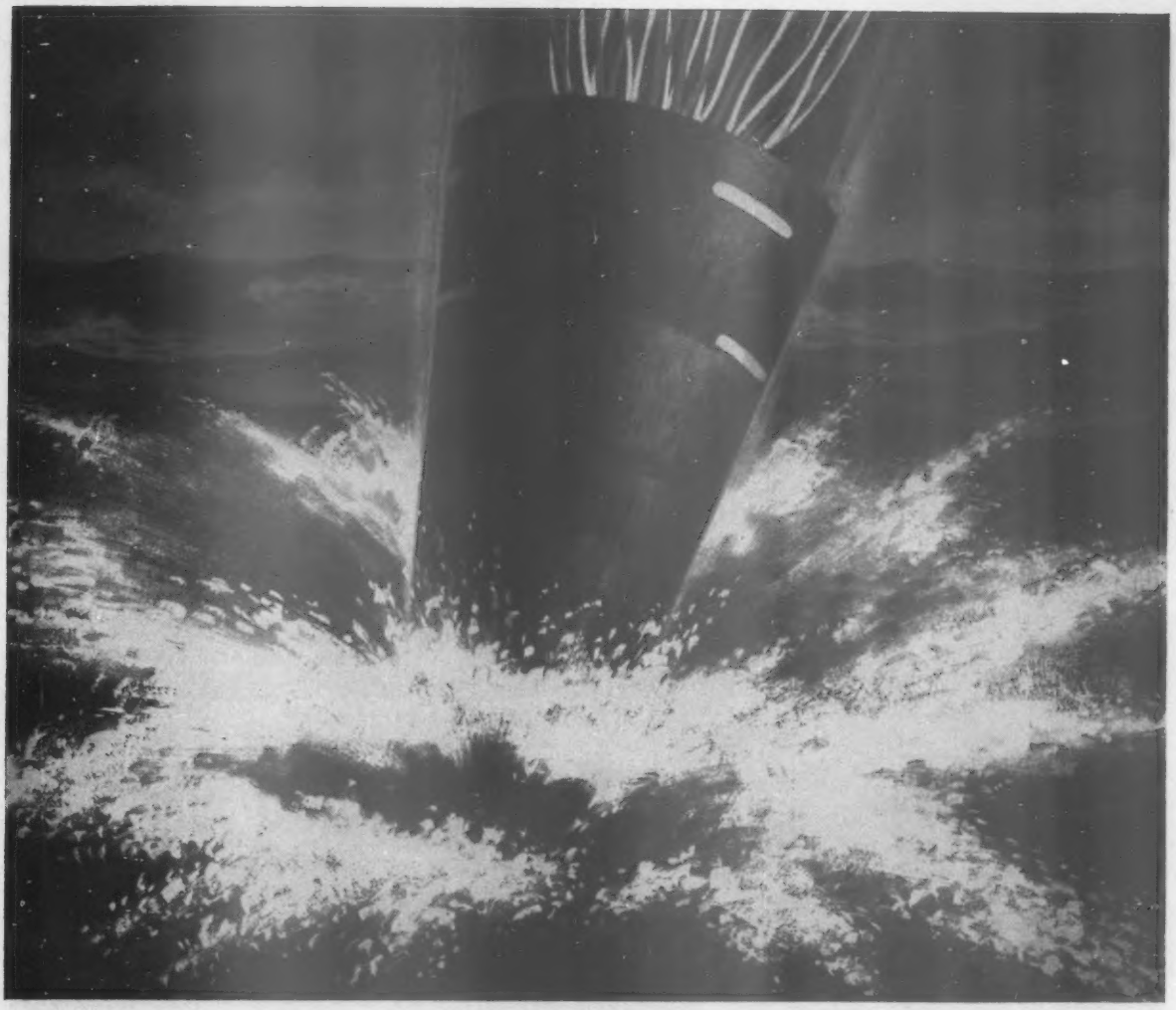

How the ocean grew "ears" to pinpoint missile shots

A quarter of the world away from its launching pad an experimental missile nose cone splashes into the ocean.

How close has it come to the target?

Where can it be found, recovered and studied?

To answer these questions quickly and accurately, Bell Telephone scientists have developed a special system of deep-sea hydrophones—sensitive "ears" that hear underwater. Its name—the Missile Impact Locating System, or MILS for short. MILS, produced by Western Electric, manufacturing and supply unit of the Bell System, involves two types of networks.

- One is a Long Distance network which monitors millions of square miles of ocean. The nose cone releases a small bomb which sinks and explodes at optimum depth for transmission of underwater sounds. Vibrations are picked up by hydrophones stationed at optimum depth and instantly carried by cables to ground stations. Since the vibrations take longer to reach some hydrophones than others, time differences are measured to compute the location of the nose cone.
- The other is a "bull's-eye" network which monitors a restricted target area. This network is so sensitive that no bomb is needed. It can detect the mere splash of an arriving nose cone and precisely fix its location.

MILS is now operating in both the Atlantic and the Pacific test ranges. It was installed by the U. S. Navy with technical assistance from Western Electric.

It's still another example of how the universe of sound—below the sea, above the earth, in outer space—is constantly being explored by the Bell Telephone System.

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The Price of Progress

SOME YEARS AGO, WHEN ARMED FORCES MANAGEMENT was first created as a medium (free of strangling red tape) for the exchange of ideas among Defense and defense industry personnel interested in improving the economy, effectiveness and efficiency of the defense business operation, we noted: "in fact, in a few years, computers may be a vital tool assisting commanders in the field in making well informed combat decisions."

The old salts, and that handful of cavalry officers who just will not admit that the charge of San Juan Hill is over now, nearly threw us out of business before we got started for having the audacity to utter such "patent nonsense" —even though their own services were already quietly working on just such projects. AFM deserves no bouquets for this kind of prophecy.

For, in fact, pointing out where computers are headed in Defense meant merely asking the right questions of a group of people who, by all odds, are far ahead of the Communists or industry or anyone else you might pick in exploiting ADP. (So far ahead that the head of Civil Service Commission said recently, in effect, there is no comparison between industry and Defense in this area.)

Defense has spotted, even encouraged, a technological revolution in ADP fully as monumental and impressive as anything that has happened in the much more publicized areas of missilery and space research. Their leadership is noted, or implied, in this issue's look at the future of ADP in Defense, the outline on what's going on in PERT, and the series of articles on military computer applications.

But if Defense EDP experts have led the world in this computer crusade, the more frank talking members of the team also readily recognize that "we've managed to make all the possible mistakes, too." At the *operating* level, Defense ADP people feel they have built up enough computer savvy to spot pitfalls early and work around them. Their chief complaint is, as it was beginning to be several months ago, that top management is still trapped in a sort of cultural lag over just what the computer can mean to an operation. In sum: "we can crank out answers with very little trouble—once management recognizes the problem is one a computer can solve."

Clues that management thinking is somewhere back in the dust:

Item—Many operations now on computers still have a series of duplicative manual operations hanging on their coattails "apparently because the CO doesn't quite believe his new toy can really do the job all by itself;"

Item—In spite of a great deal of enthusiastic conversation about the management breakthroughs wrapped up in PERT, management has not even begun to think about its potential as a tool in running whole big areas of defense operations;

Item—Few top people have paid much attention yet to the fact that ADP casts some serious doubts about the validity of a host of the organizational layers which currently clog the operating machinery.

There are some indications (unfortunately, precious few at the moment) that management enlightenment is coming. But until ADP is taken out of some dusty nook in a comptroller's office and made a decision tool top management uses as often as it uses the telephone, Defense, even though a leader in the field, is going to fall far short of realizing the tremendous potential of its electronics inspectors general.

Bill Borklund

There's Still Time

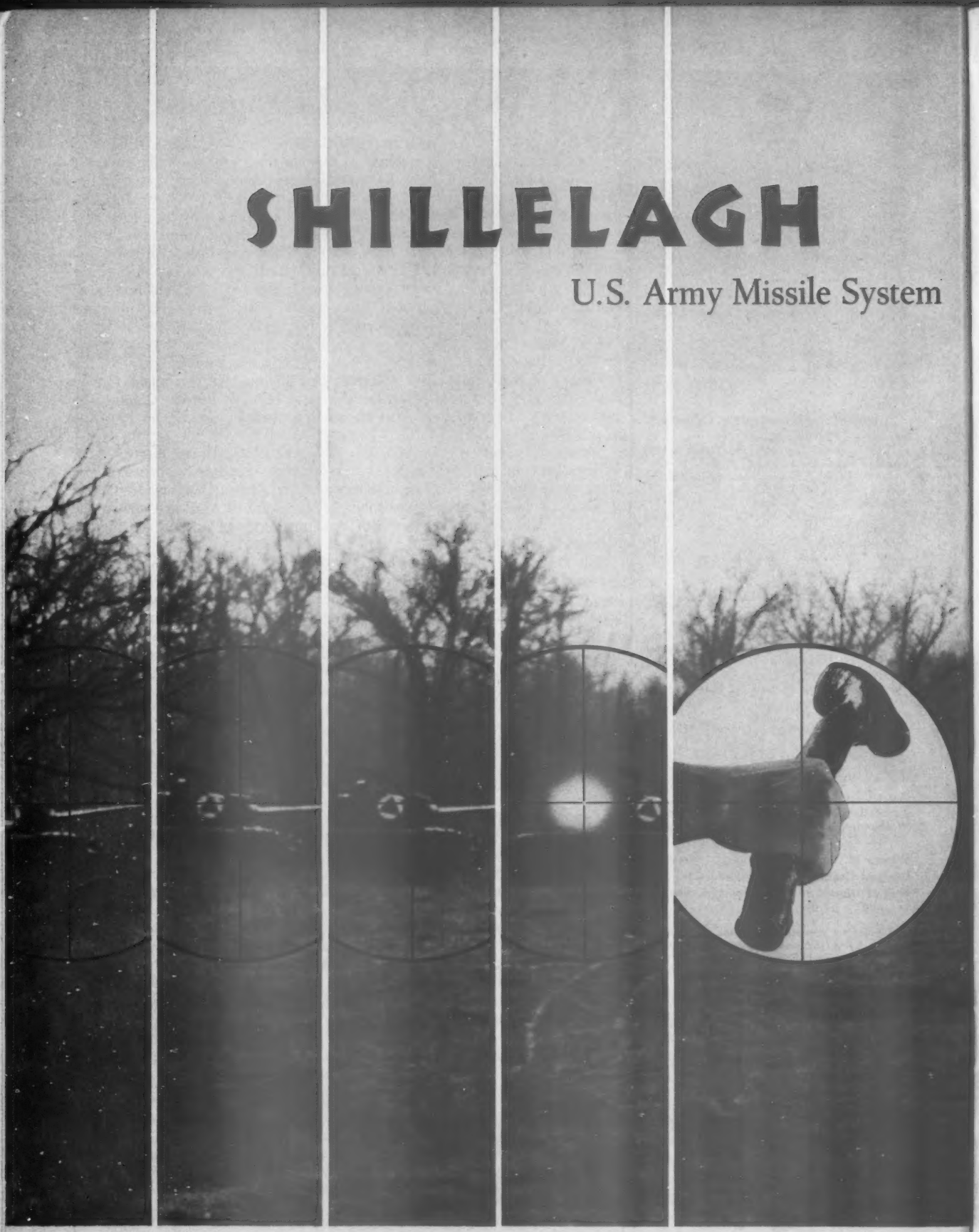
In the June issue, ARMED FORCES MANAGEMENT printed an editorial questionnaire, designed to find out if you think this magazine is giving you the information you need—and what we should do about it if it isn't.

According to the statistical experts, returns have been very gratifying. But the editors, bless their idealistic hearts, would like to see *everybody* answer. If you haven't already, would you take 10 minutes to fill out the form and send it in.

Answers received by the end of July will still figure in the final evaluation.

SHILLELAGH

U.S. Army Missile System



The SHILLELAGH is being developed for the U.S. Army under the over-all direction of the U.S. Army Ordnance Corps.

The United States Army **SHILLELAGH** surface-to-surface guided missile–like its Irish namesake–will be simple, reliable... lethal. Against enemy targets–moving or stationary–**SHILLELAGH**'s accuracy and firepower will provide the U.S. Army a devastating new weapon that kills with a first-round probability approaching unity ...and at ranges never achieved in antitank warfare. **SHILLELAGH** is now under development at Aeronutronic, prime contractor on this advanced weapon system.

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SHILLELAGH is one of many advanced programs currently under development at Aeronutronic's new, million-square-foot Engineering & Research Center at Newport Beach in Southern California.

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THE GRUMMAN GULFSTREAM
In a brand new "off-the-shelf" military transport version

- **for air evacuation**
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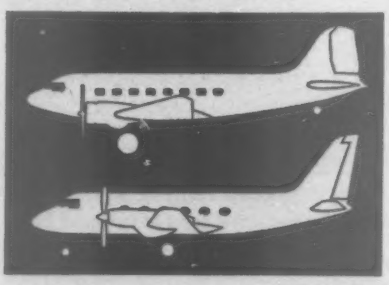
Military transports of World War II and Korea vintage performed admirably. But today they deserve to be retired as befits any battle-weary veteran.

Typical of such transports is the DC-3—one of the finest, most reliable airplanes of its day. Its size, and ability to land and take off from virtually any military field, made it an extremely flexible transport. It has served faithfully in many roles over the past 20 years and has proved to be an excellent military investment. The Grumman Gulfstream is ready to serve as the optimum in military transport for the *next* 20 years, and as a comparable investment.

In the illustration, right, you see two airplane silhouettes: the first, a DC-3; the second, a Grumman Gulfstream. Note how closely they coincide in size. The Gulfstream is the modern pressurized, high performance replacement for the DC-3 and other older transports; equivalent to the DC-3 as a work horse transport—and costing even less to operate—the Grumman Gulfstream is a new airplane proved in service by over 60 world-wide corporations and the Federal Aviation Agency. Modernization of our country's airlift capacity for limited or brush fire warfare can be accelerated by the Grumman Gulfstream. And it's available *now*.



Gulfstream compared to DC-3

Facilities inspection

Here are the Gulfstream's capabilities: For military application, it will carry up to 24 passengers and has a transcontinental range against 50-knot head winds. It needs only 3,000 feet of runway, enabling personnel to use fields close to their destinations. It is completely independent of ground

Air evacuation

handling facilities. With its pressurization system (up to 30,000 feet), it flies above weather and traffic at a cruising speed of 350 mph and is powered by proven turboprop Rolls-Royce engines. An active develop-

Multipurpose Gulfstream cabin

ment program is in progress at Grumman for the installation of the General Electric T64 turboprop engine as an alternate source of power.

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ARMED FORCES Management

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JULY, 1961

Volume 7—No. 10

FEATURES

Combat Computer Boosts Navy's Sea Punch 14

Command control of sea warfare, when and if it comes, will require more than the grease pencil plotting boards of the past. That's why some of the best brains in the Navy were told to develop electronic command coordination. They produced the Naval Tactical Data System which portrays the panorama of surface, air and subsurface operations instantaneously by computer.

Where PERT Is Headed 16

Extraordinary success in its application to Polaris has given PERT—the Navy's Program Evaluation and Review Technique—a stature unequalled in modern management. Widespread adoption by industry and the other military services appears inevitable.

What's Ahead for Defense ADP 19

Recognition of ADP's capabilities and the enormous strides made in developing the system can be credited in large part to the Defense Department, specifically to its Data Systems Review Division. New fields of usefulness are expected to open with COBOL, the computer program language.

Pentagon Profile—This Month: Capt. Edward C. Svendsen, USN 24

The project officer for the Naval Tactical Data System has devoted six solid years to this job and feels that success justifies all his lost holidays. He had help, both from the Navy and industry, but his own brains and drive were indispensible. NTDS is now operational on four ships and before long will be installed on most of the major combat craft.

What Computers Are Doing About the Weather 28

The weatherman hasn't lost his job yet, but he has a formidable rival. Weather forecasting by computers with an accuracy and dependability hitherto unknown will soon be a reality.

Is Management Ready for ADP? 34

A Comparison of Major Computer Systems 41

ADP Expands Schooling 49

The Army employs a computer to multiply the decision training of logisticians at its Fort Lee school.

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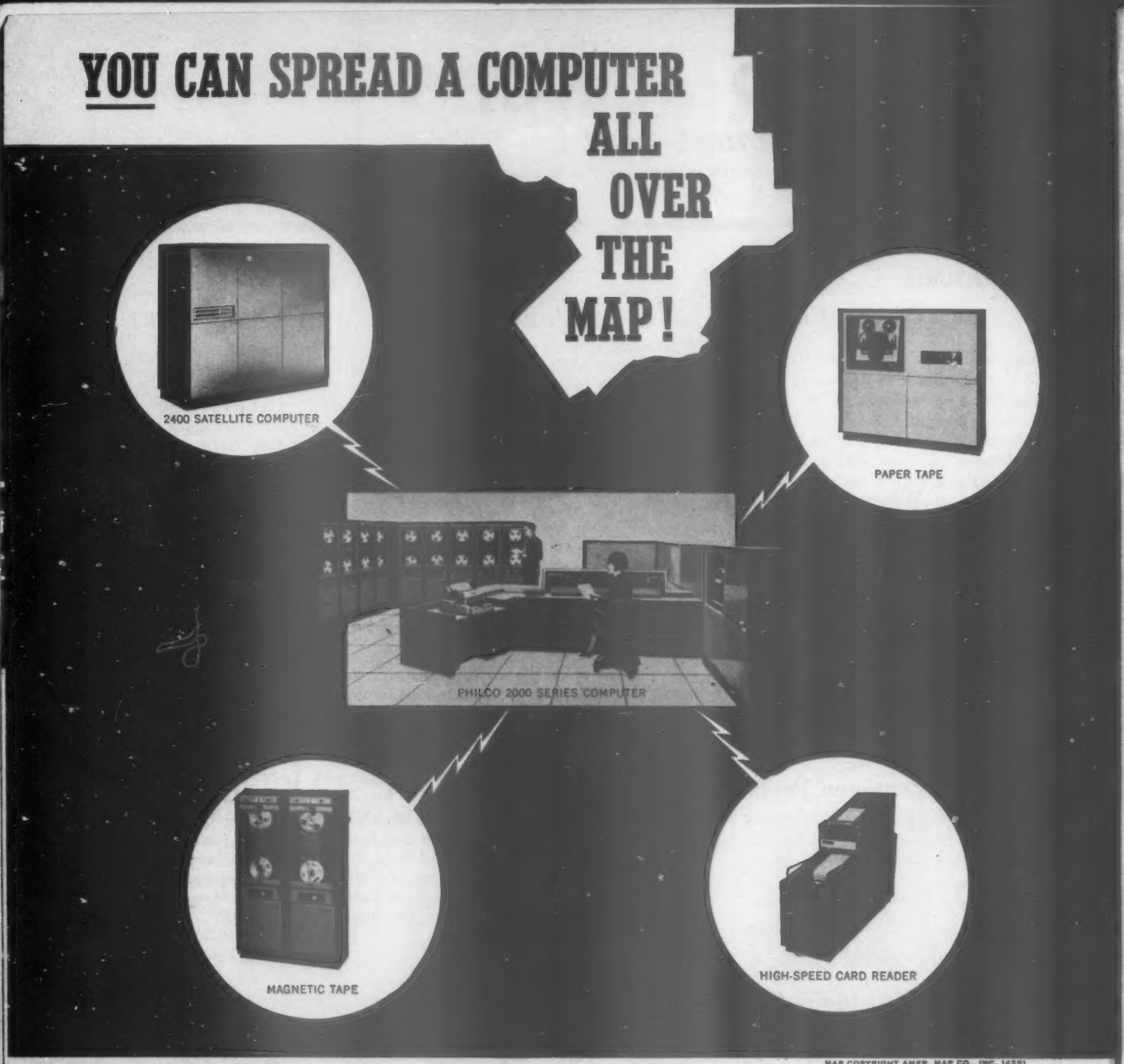
NEXT MONTH:

Progress Report on Mark Bradley's Money Tree . . . Pentagon Profile: How Hitch Will Handle the Budget . . . Single Manager for MATS, MSTS and MTMA

YOU CAN SPREAD A COMPUTER ALL OVER THE MAP!



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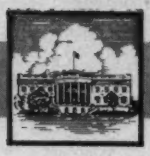

Washington Background

Unification Trend Stronger?

A handful of Pentagon systems analysts are quietly, and privately, discussing what they term "an interesting set of reasons why the trend to Service unification is much stronger than generally realized."

One of the currents in the stream: automation of Defense reporting procedures. "The computer and automation have as their object the fast disclosure of information to any organizational level wanting it. Thus, with automation, control can be exercised from as high up, or down, as top management desires."

The reason, basically: automation permits the Defense Secretary, for instance, to know as much about what's going on in any particular division as the division chief himself—and just as fast.

PERT Is Adopted By Air Force

The scope of PERT, the Program Evaluation and Review Technique originally applied by the Navy to its Polaris program, is being widened to apply to the Minuteman, Atlas and Titan projects in the Ballistic Systems Division of the Air Force Systems Command. BSD is implementing the technique through "in-job" training and design to spell out just who does what, when and how much on each of the projects. The Air Force PERT program will supplant its PEP, or Program Evaluation Procedure, and is expected to produce a complete management system in eight or nine months, as compared with the Navy's three years on the Polaris program.

Defense Divided On PERT Merit

Although the Navy Special Projects Office and the Air Force Systems Command have gone into extensive studies of PERT and its advantages, there are still far too many in the Defense Department who are skeptical about the merits of the new program. Its supporters, however, are outspoken. One comment of a PERT advocate: "In the 50's we found out how to do these things—in the 60's we'll find out how to implement them. One thing about PERT, it's moving—fast."

Future prediction: By 1970, there will not be a major weapon system under development which hasn't used the PERT system for either programming, costing or reliability—or all three.

Army Junks Pentomic Units

Adoption of the battalion building block principle for the Army's reorganized division structure is being acclaimed at the Pentagon as a victory for the philosophy long advocated by the "tankers" of the Armor Branch. Their theory: shock action and firepower as keys to maximum combat efficiency can best be achieved by maintaining the division as a pool of battalions from which task forces can be formed as dictated by the mission. It was on this basis that the Armored divisions have been operating since early in World War II.

Defense Eyeing Army School

The Defense Department reportedly is considering taking over the Army's Logistics School at Fort Lee, Virginia, and employing its computer-assisted instruction courses for the advanced training of logisticians from all the Armed Services. The school is the major activity of the Army's Logistics Management Center. Its faculty is composed of Army officers and civilians, and its students, with few exceptions, have been Army personnel.

The plan is understood to have been proposed following a recent inspection tour of the school's operations by a number of Pentagon officials, including Thomas D. Morris, Assistant Secretary of Defense for Installations and Logistics. The Pentagon group was described as particularly impressed by the intensity of the training made possible by the unique use of the computer in the simulation of logistical problems.

CREATIVE ELECTRONICS BY RCA

"WEATHER EYE" IN SPACE

RCA-NASA Development of TIROS Advances Progress in Worldwide Weather Forecasting

From its vantage point in space, TIROS is sending down to earth new, more definite pictures and data of the world's everchanging weather patterns to aid man in his ageless efforts to control the elements.

Incorporating revolutionary and advanced electronic equipment, TIROS was designed, developed and built by RCA's Astro-Electronics Division for National Aeronautics and Space Administration. Within its small circumference are miniature TV cameras, tape recorders, TV transmitters, command receivers, timing mechanisms, beacons and telemetry equipment. In addition, it carries new scanning and non-scanning Infra-red Sensing Devices, developed by NASA, to measure and record the heat radiation of the earth and its cloud cover, and a revolutionary new Magnetic Orientation Device to capitalize on the effects of the earth's magnetic field and maintain favorable orientation of the satellite for long periods.

BMEWS—RCA Electronics Equipment and Systems contribute to the alert status of the Nation's vast outer perimeter early warning system.

DAMP—at the Caribbean down-range missile testing "slot," the highly complex DAMP vessel is equipped with RCA electronic tracking devices.

ATLAS—an RCA-developed checkout and launch system reduces substantially the "countdown" period required for launching this missile.

RCA developments in miniaturization, reliability, computing and overall electronic activities are contributing to many of the nation's leading space and missile projects. For information describing new RCA scientific developments, write Dept. 434, Defense Electronic Products, Radio Corporation of America, Camden, N.J.

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The Most Trusted Name in Electronics

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Combat Computer Boosts Navy's Sea Punch

Dedicated work by zealous crew of Navy scientists—aided by industry—produced operational ADPS for task force action five years after research and development was launched. Computer coordination of fleet maneuvers gives commanders new capabilities for sea warfare of future.

by Paul Conlin

One of the features of the compact design of the NTDS computer is its rollout drawers which permit easy and rapid access to the component packages.

A FEW YEARS BACK, the Navy hand picked a handful of smart young scientists in uniform for a revolutionary assignment. Their orders in effect read:

"The grease pencil plotting board will never be able to keep up with the sea action of the future. Come up with an electronics solution."

On a seven-days-a-week, forget-about-holidays, basis, the group went to work on what came to be termed the Naval Tactical Data System. With one or two exceptions resulting from natural attrition, the group is still intact under the command of Captain Edward C. Svendsen, of the Bureau of Ships.

Dedicated work by competent hands has paid off. The Naval Tactical Data System is now a reality. Currently, NTDS is being installed on four ships: the Carrier *Enterprise*, another carrier operating from the West Coast, and two destroyer leaders (guided missile) —DLGs.

In addition, plans have been announced for an NTDS installation on the Nuclear Powered Cruiser *Long Beach*. Eight more NTDS installations are being authorized on the basis of the current budget.

Eventually, most major combatant ships in the Navy will be equipped with NTDS, giving each a computer-fed schematic picture of enemy targets, their type and movements, and the defensive and offensive postures of friendly ships and aircraft.

Continuously collecting this information from radio, radar, sonar, electronic counter-measure and other communications systems, NTDS simultaneously compares its findings with the data being received from the computers on the other ships in a task force. Memory cells which have previously stored information on the capabilities of friendly and enemy ships, aircraft, and missiles, enable

NTDS to furnish the commander with a series of alternate recommendations on the weapons which should be used against the enemy.

The commander may accept the NTDS recommendations, or he may make another decision based on his own judgment. In either event, the system stands ready to transmit his orders to his own fire control center or to the ships and the aircraft which will participate in the attack.

As explained by the Navy, the computer-to-computer data link of NTDS by means of powerful single-band radio communications coordinates an entire task force in the equivalent of a single-ship operation, "expanding the effective scope of instant command decision functions to ocean-wide dimensions."

Absolute Control

The management of the NTDS group was unique in that Captain Svendsen was free to call on the Navy's bureaus and other agencies as well as industry for help whenever he felt it was necessary. Absolute control of the NTDS project was vested in the Svendsen group, but the Captain could range at will for the specialized technological and engineering talents needed for the solution of the problems that constantly beset the program.

Because of this arrangement, NTDS itself cannot be classified as a costly program in dollars and cents. As Captain Svendsen put it: "Compared with projects of comparable scope, we only spent peanuts."

In the background, however, were a number of basic factors which contributed largely to the project's success. Among them: strong support by a "good team" headed by Capt. P. L. Folsom in the Office of the Chief of Naval Operations for operational requirements, budget support, and presentations and justifications at the Pentagon Building; the manpower equivalent of five full-time engineers in the Bureau of Ships; the services of some 130 experts at the Naval Electronics Laboratory on such vital matters as communications, radar displays, operations analysis, and Research and Development evaluation.

Also credited with a major assist were the three principal industrial contractors: Remington Rand Univac Division of Sperry Rand, Collins Radio, and Hughes Aircraft.

One of the project's basic arrangements gave the contractors the complete job of developing and producing the essential ingredients of the equipment. But, looking over the contractors' shoulders were the scientists and engineers of the Naval Electronics Laboratory and from them came the feedback on what actually had gone wrong or what might go wrong.

This kept the Svendsen group constantly aware of both sides of the story —from the viewpoints of both the contractors and the Navy. As one of the Navy group explained it: this arrangement tended to emphasize that the Navy's in-house capability is an invaluable check on the performance of contractors, and enabled the Navy and the contractors to take early corrective action where necessary.

The first contracts were let to Remington Rand, Collins, and Hughes in 1956. Under management of the Bureau of Ships, the NTDS contractors were selected on the basis of established superiority in their fields.

The Research, Development, Testing and Evaluation program through Fiscal Year 1965 has earmarked about $80-million to NTDS and the bulk of this total—amounting to about $60-million—has been expended to date. The entire NTDS program will extend through 1970 and will amount to about $800-million. This includes construction and activities at the Fleet Computer Program Center on the West Coast, and the amounts allotted to the Bureau of Weapons, the Bureau of Personnel and the Bureau of Ships.

The Future Outlook

The rate of progress on the NTDS project can be gauged in part by the fact that approximately two years after the first contracts were let in 1956, Research and Development activities at the Naval Electronics Laboratory were in full swing in 1958. This phase has been virtually completed. Five years after the first contracts were let, the Navy started the actual installation of the equipment aboard ship.

Remington Rand had acquired years of experience in the production of electronic computing systems when it was awarded its first NTDS contract. But the Navy requirement was for a system which could be installed in the comparatively cramped space available on ships. It had to be rugged enough to withstand the effects of shock, vibration, and salt air corrosion. This called for a radical departure from the design concepts utilized previously.

The company met the requirement by producing a real-time digital computer which it describes as the smallest yet most capable piece of large-scale data processing equipment ever built. It is approximately the size of an ordinary office desk—three by three by six feet and it takes up about nine square feet of floor space.

The new machine was christened the Univac Advanced Navy Computer and it is the heart of the NTDS installation. Its capability is equivalent to the work load capacity of two of the company's Univac 1103 computers each of which requires some 1,400 square feet of floor space.

Requirements Met

Requiring about 2,500 watts of electricity, the new NTDS computer utilizes transistor-diode circuitry and thus avoids the generation of heat and the major power requirements involved in the operation of "giant brain" computers using vacuum tubes.

The key to the compact design and to the maintenance of the new NTDS computer is modular or building block construction. Its memory is a magnetic core matrix and its muscles are germanium sandwiches and tiny iron oxide doughnuts.

The NTDS computer is described technically as: "A general purpose, stored-program machine with a very high speed, random access memory containing one million bits of information." The NTDS staff explained that one computer word is comprised of 30 bits and these may be extracted in about 2.5 millionths of a second.

Collins Radio produced and supplied the high powered, single sideband radio equipment which interconnects the computers aboard the ships carrying the NTDS installations. The Central Division of Collins, at Cedar Rapids, was responsible for the radio frequency gear, the Collins Western Division at Burbank furnished terminal equipment, and management and systems engineering was provided by a Collins subsidiary, the Alpha Corporation, of Dallas.

The Hughes Aircraft Company produced the data display equipment for NTDS at its ground systems facility, Fullerton, Calif. The data display group is made up of electronic display consoles which provide pictures of an entire tactical situation or selected portions of it, as desired.

The consoles are manned by operators trained specially to perform a function related to the information collection and decision making required to evaluate and resolve the tactical situation.

The entire task force can be made plainly visible by the display consoles, it was explained. The ship's position in the group is shown, as well as enemy targets, their type and intent, friendly aircraft and ships and their defensive posture. Accordingly, key personnel can comprehend the immediate situation readily, and can concentrate their

(Continued on page 30)

For Managers, Progress Depends on . . .

Where PERT Is Headed . . .

by James Lewis

Photo by Yoichi R. Okamoto

Donald G. Malcolm
Vice President, Operations Research Incorporated

DEFENSE AND INDUSTRY got their first look at PERT (Program Evaluation and Review Technique) when Navy's Special Projects turned out a Polaris firing nuclear submarine years ahead of schedule using a top-notch management staff and this dynamic management concept.

With present day technology being as complex as it is, programming a weapon system without using PERT (backed by a top management group) could be compared with driving a horse and buggy down a busy highway. Although eventually getting there, you would find that progress had left you hours and days behind; and in the case of PERT, years behind.

A Gimmick?

Even though PERT is looked upon by some as just another management gimmick, it is the only system that provides managers with instant information in the achievement of current objectives. It is the only system which allows the manager to see what effect one event of the program will have on another event.

Simply, PERT can measure top management performance. There is no longer any room for interpretations on what management did wrong. The results are seen immediately. PERT forces management to list what it is going to do, shows what the implications are on the other offices involved (including some that management may not even be aware are involved) and measures progress. This is probably the big reason top management has been slow in accepting PERT—it shows weaknesses that would go otherwise undetected. However, once they do accept PERT, they readily admit their mistakes and are almost always advocates of the program.

How It Works

There are two outstanding features of the PERT system. First, it gives an interdisplay of interrelated events, and secondly, it shows the critical series of events (commonly known as the critical path). This is really the backbone of the program because it shows the manager (on paper) something that has never been done before —where events are falling down—and allows him to spot check project progress at will.

When a PERT system is first instituted on a development program, it displays graphically a network of interrelated activities with the final event being the completion of the program. (See graph).

Next step is to obtain three estimates from engineers and those working on specific activities which represent the range of time which can be expected. These are then transformed into a probability statement indicating the chances of the activity taking different lengths of time to be achieved.

These estimates, along with the flow plan, are fed into a computer which computes and sorts out the longest path from all the possible paths to any event. Paths leading to an event which have slack time represent those with resources which potentially may be reallocated. The paths leading to an event with no slack time represent areas of the critical path.

The critical path provides the manager with information on where slips are likely to occur and what their magnitude may be. One advantage of slack time: it allows the manager to see where he has extra resources and enables him to channel these to events in the critical path.

As Changes Occur

During operation of the PERT system, information is fed into the computer to maintain and update the system according to a regular plan—normally bi-weekly. However, information may be fed into it at any time the manager so desires. The computer also allows the manager to simulate changes without actually disrupting the program. This way he can find out what effect on the overall program a time

Much activity is being generated in the management field by a handful of men. The activity is centered around a dynamic new management tool, Program Evaluation and Review Technique, the potentials of which are being realized more every day by managers in Defense and industry. One thing for certain: PERT is one of the greatest revolutions in management history.

reduction on one event would have.

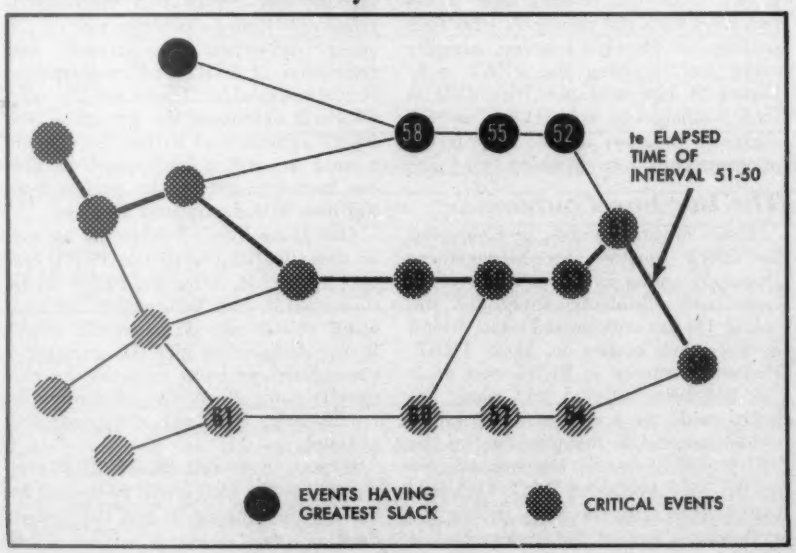
One point those working with PERT seldom fail to emphasize is that in order for PERT to be effective, it must be run by people who know what they are doing. Like all systems involving a computer, pumping garbage into the machine guarantees garbage coming out. It is not a panacea. And if it has uncovered anything so far it has established pretty clearly (though unofficially) that management is in trouble. The problem area is not in the top decision making, but in the implementing decisions on how to carry out the plan. It is here, according to informal conversation among people knowledgeable so far, that management falls down—as PERT regularly and impersonally points out.

What It Requires

PERT requires the most of team effort, at all levels, from top to bottom. The program will fold if one person in the system fails to carry out his responsibility, whether he be top manager or an engineer in charge of a small component.

Significantly, PERT could be summed up as: (1) representing a fundamental operational approach to R&D planning and scheduling by describing the R&D process as a network of interrelated activities, (its use will cause a very pervasive change in planning methodology since it faces up to the coordination problem involved in an R&D program; (2) demonstrating that fast means of uniform, standardized communication concerning large-scale programs can be economically developed; and (3) focusing attention on the payoff of "research on management-systems" and points the way for better integrated planning methods in the cost and technical performance areas. In this regard, it has generated a new enthusiasm and a hope in many staff planning activities whose members have generally felt somewhat unrewarded and frustrated. This motivation should be encouraged.

The Critical Path In A System Flow Plan



The newest areas of PERT application (and these are still in the trial and error stages) are cost and reliability.

Other Applications

In implementing costs in the PERT network, it would be necessary that project network and activity elapsed-time estimates be obtained in the same manner as prescribed by basic PERT, making certain that the activities are homogeneous and directed to some objective or event. In addition to the elapsed-time estimate, the basic inputs for a basic PERT cost system are the direct man-hours by type and employee number; direct expense items, applied or planned to be applied to a particular activity; and a departmental code to assist in the collection of cost data by organizational function.

It is possible to expand the basic cost system by obtaining a range of input cost estimate or a cost function for each activity.

With the data obtained, the following output reports are then possible in a company using the basic PERT cost approach:

1—Expected manpower requirements by skill, month, and department.

2—Individual man loading by month.

3—Expected project direct costs by skill, month and department.

4—Regular PERT time outputs, slack areas, critical path, expected calendar time, and impact prediction.

Costs Output

Costs output would then be used for evaluating cost-time tradeoffs, determining and improving utilization, balancing the workload, determination of percent of directed work, scheduling of manpower buildup and identification and assignment of technical work.

Under the reliability (as applied to PERT) application of PERT, reliability is controlled in effect by the nature of organization and by planned develop-

Dr. Richard M. Greene, Director, System Training Centers, ORI, instructs students on the use of the Clary DE-60 computer used in ORI classroom work.

ment approach itself. A new approach to the problem of reliability has been to design and hopefully develop an information system using some of the PERT features which would inform management of the predicted reliability based on current design and production practices.

New Methodology

Working as a team, Navy's Special Projects, Operations Research Inc., and Lockheed Aircraft Co. are currently implementing a new methodology for estimating and monitoring the reliability status of fleet ballistic missile systems. The project, labeled Project PRISM (Program Reliability Information System for Management) has these objectives: (1) to develop a capability to provide performance trade-off information concerning the program approximately two years in the future; (2) to develop a capability to quantitatively depict the expected reliability on the subsystem level; and (3) to provide a means for the technical management to define and assess the activities making up a reliability program.

Although this is only a basic sketch of the PERT concept, it represents what has taken management years to discover. It has been described as in its adolescent stage. Yet, no one has really been able to say to just what extent the PERT system can run and just how far into a program it can go. It is being used on a project presently whereby PERT is perting PERT. In other words, they're using PERT to check on the present PERT system. Reason: it's being done on a system so complex that it's required in order to boil down the different portions of the PERT system. However, as one PERT disciple puts it, this wasn't *necessarily* the reason for the successful firing of the first Minuteman.

Several companies have launched concerted efforts to spread the wealth of knowledge on the real implications of PERT and its pitfalls. Among the leaders, the Operations Research, Inc. group. Their university-type courses amount, roughly, to 75% of the effort going on in this area right now. As even they insist, far more activity must be generated in this area if the full potential values of PERT are to be realized by top management, both in the military and in industry.

Their courses consist of "in-shop" and "in-plant" programs. The in-plant being offered within a company and the in-shop being those courses offered by ORI (classroom type) for representatives from commercial, industry and military.

In their in-plant course, ORI sends a team into a company to familiarize managers with PERT. They conduct a two week course and then spend two days with the managers who then perform on the job training, actually using and applying the PERT techniques. A representative from ORI is then available to spot check on the company program and to help if the program runs into trouble.

The In-Shop Course

Their in-shop course is conducted by ORI's Institute for Management Dynamics and is set up on a university-type basis. Students apply for the course (or are volunteered) and attend a one week course in basic PERT. Presently, courses in PERT cost analysis are being offered and plans are being made for a course in reliability.

Instrumental in the spreading of the PERT philosophy to Defense-industry is ORI Vice President D. G. Malcolm, who worked with the Navy during the embryonic stage of the system and is credited as one of the co-founders of the PERT information setup. Malcolm is highly respected in top management circles for his knowledge of PERT and for his devotion to a system which has, so far, failed to prove him wrong in what he has been preaching.

His latest contribution to the PERT program is a plan for establishing a Program Management Center. When set up, this will become one of the most important parts of an operating PERT system. The center will provide a central "meeting place" within a company, bringing together the weapon system manager, contractors and subcontractors.

Within the center itself will be PERT orientated data input displays which are merely PERT updated graphs visually showing progress or slack in the program. What this will really mean to managers, large or small, is that they will have a chance to see what others are doing on the program and discuss with them problems which may occur in proper context. They can see where the problem is and its effect on the combined effort of other people.

Other People

Also working with Malcolm are ORI staff men Herbert Groelinger and Herbert Millstein. Groelinger is project manager for designing and implementing extensions of PERT in costing, and Millstein is project manager for implementing PERT in major weapon systems. While working on their respective projects, these men also fill in as instructors for students enrolled in ORI classes, both in-plant and in-shop.

Although the staff of the Institute for Management Dynamics (assigned the responsibility for research, design and implementation and training for management information systems) is relatively young—average age is 38 years old—their background and knowledge of PERT and its extensions is unquestionable. These are the men who will determine the growth of the PERT system, and so far, have made a good accounting for themselves. This has been brought out by praises from top men in industry and Defense.

One thing they all agree on, as well as those working with the PERT system, is that in order for PERT to be successful it *must* be useful to the man using it—at all management levels. It was designed to give the manager a streamlined program whereby he can operate more effectively, efficiently and intelligently. It is not a management gimmick.

In sum, any difficulties PERT may run into in the future will be caused by the people running it, not the system itself. ■

What's Ahead for Defense ADP

Defense experts anticipate that use of automatic data processing techniques by the military will mushroom in the next few months, have been hard at work preparing for the explosion. Here are just some of the highlights and what they can mean . . .

by C. W. Borklund

THE TENANTS in room 3B857, the Pentagon, received a large wooden crate one day last month, addressed to their boss, Charles A. Phillips, director of the Defense Data Systems Review Division (see July, '60, AFM).

Inside the crate: a laugh provoking white marble tombstone. On top was a sacrificial lamb. Chiseled into the tombstone's face in four-inch-high gold letters was one word: COBOL (for Common Business Oriented Language). The needling gift was from a top programmer, and Phillips' close friend, at the Radio Corporation of America.

A representative of International Business Machines, in Phillips' office when the package arrived, said, "You know what we're going to do with this, Charlie? When you pass to your reward, this should go to the head of your grave."

That one incident is indicative of a great many things about computers and where Defense fits in the picture. Among them: (1) the intense competition among manufacturers, the sharp ones, who recognize just how big a giant Defense is in the automatic data processing field; (2) a clue to the kind of leadership Defense is exercising in a field so explosive it could well revolutionize the military way of running its operation.

Defense has been a ringleader in adopting and utilizing the ADP revolution. Data processing experts permeate the whole Defense organization. The military effort in taking advantage of the recent computer technological revolution stands as an outstanding refutation of the weary canard that the U.S. military organization is, by nature, a dusty, inefficient, slow-moving outfit.

But, as with all pioneers, Defense has made mistakes and will probably make more. Here are eight common ones:

1—Manual procedures often continue long after a computer has presumably taken over the job, i.e. there is sort of mental "cultural lag" on the part of the users to completely trust the machine.

2—Information is put into an ADP channel, and a computer pumps out reports that frequently have no business being put on a computer in the first place.

3—Machines produce more data than management can intelligently use, i.e. ADP ability to pour out reports has been abused.

4—Military department use of ADP has often suffered, at least in the planning stages, from lack of enough top level attention, cross-service coordination.

5—Installation commanders have often gotten a computer just to "keep up with the Joneses" rather than because of any clear cut conviction that it will help them manage their operation better, have capped that mistake

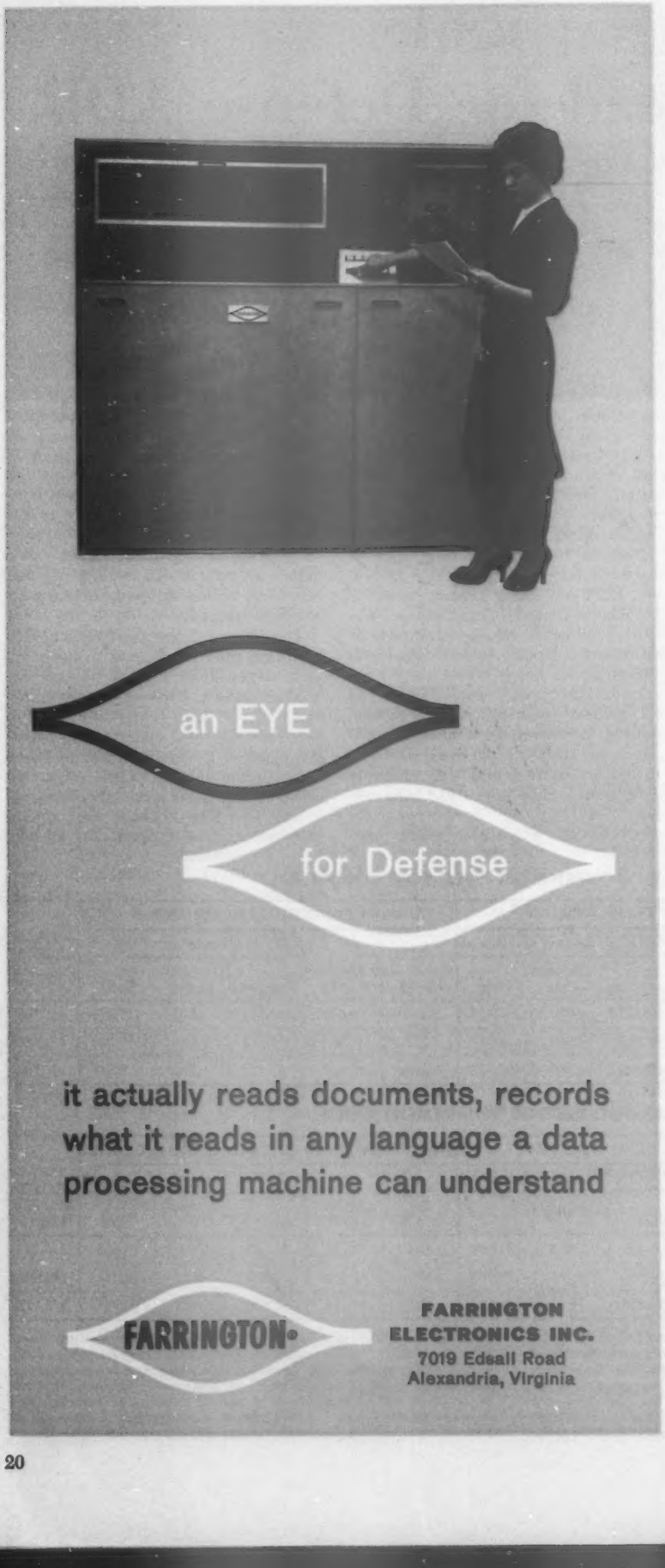
WHAT U.S. GOVERNMENT SEES FOR COMPUTERS

FISCAL YEARS	ADP UNITS WITH COMPUTERS						UNITS WITH PUNCHED-CARD EQUIPMENT ONLY					TOTAL COSTS ALL ADP UNITS
	NO. OF UNITS	NO. OF COMPUTERS	MAN-YEARS	COSTS (Thousands of Dollars)			NO. OF UNITS	MAN-YEARS	COSTS (Thousands of Dollars)			
				Operating	Capital Outlay	Total			Operating	Capital Outlay	Total	
1960 (ACT)	355	531	29,581	312,065	35,761	347,826	1,287	19,085	114,663	1,310	115,973	463,799
1961 (EST)	470	755	34,252	391,811	50,506	442,317	1,320	17,957	109,618	1,445	111,063	553,380
1962 (EST)	563	971	38,198	463,996	33,747	497,743	1,267	15,817	97,797	720	98,517	596,260

BREAKOUT: DEFENSE DEPARTMENT ONLY

FISCAL YEARS	ADP UNITS WITH COMPUTERS						UNITS WITH PUNCHED-CARD EQUIPMENT ONLY					TOTAL COSTS ALL ADP UNITS
	NO. OF LOCATIONS	NO. OF COMPUTERS	MAN-YEARS	COSTS (Thousands of Dollars)			NO. OF UNITS	MAN-YEARS	COSTS (Thousands of Dollars)			
				Operating	Capital Outlay	Total			Operating	Capital Outlay	Total	
1960 (ACT)	218	360	20,843	210,306	12,636	222,942	772	14,080	77,159	707	77,866	300,808
1961 (EST)	298	493	24,083	260,963	14,781	275,744	799	13,214	72,729	622	73,351	349,095
1962 (EST)	376	661	27,018	304,054	9,547	313,601	750	11,116	61,408	303	61,711	375,312

Above, from a Budget Bureau report to be published in July, is an estimate of how big the automatic data processing field will become for the Federal Government by mid-1962. As figures show, Defense portion of the picture, based on a number of units, amounts to 68% for computers, 60% for punched-card equipment. Dollar operating figures include both equipment rental (and/or purchase) and personnel salaries. Significantly, although Defense will increase its computer acquisition some 83% from FY '60 through '62, costs will increase only 40%, which Defense interprets to mean that computer hardware costs are going down. Note: Count on estimated number of computers does *not* include those in use or anticipated for classified defense installations, i.e. equipment used for fire control, intelligence, tactical combat and similar jobs.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6—EDP proposals requesting Pentagon approval almost consistently underestimate costs and almost as consistently overestimate savings.

7—While a great deal of attention has been given to effective use of the computer at many installations, too little has been devoted to improving the before-and-after operations, i.e. quality and accuracy of the source information, for instance, still needs vast improvements.

8—Computer almost invariably ends up being given more work to do than had originally been planned—too often with no real thought as to whether it should be doing some of the work or not.

Still, although the Defense has stumbled occasionally, the management improvements have far outweighed the mistakes. No single story could detail all the advances but, in broad brush strokes, among the major benefits derived from ADP installation: the elimination of accounting and reporting backlogs, reduction of errors and adjustments, more timely reports, and consolidation of certain accounting and management information.

Most significant aspect of all this Defense activity: there is probably no other area into which the Pentagon has moved in recent times in which there is such a concise, clear cut program to take advantage of all the advances, correct mistakes in a hurry, cross-feed information from all installations to all others (regardless of service affiliation) on problems and progress.

Ringleader in this crusade is Phillips' Defense Data Systems Review Division in the Pentagon. Ultimate focal point for all Defense ADP activity, Phillips' office handles, among other things, a running evaluation program of computer installations.

The procedure: one year after an installation is "on the air" with a computer, a DSRD representative runs an on-site analysis to determine what the computer really did played against what the installation hoped it would do. They have run about 60 of these studies in the past year alone. Some of the results, generalized, were noted above.

For example: an overseas installation over-estimated savings, predicted they would save 44 spaces, found they actually saved only 30—which still offset the cost of the installation, incidentally. The reason: they hadn't

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Other Successes

But evaluations of computer use are not the only things Phillips' staff does. Most outstanding recent success has been their leadership in developing COBOL.

Called by Phillips "our big success so far," COBOL started as an idea during a mid-1959 meeting of computer users, manufacturers and teachers when they concluded that it ought to be feasible to develop specifications for a problem-oriented but machine-independent language for programming business problems. (Until COBOL, programming had to use the machine language. Net result: program developed for an IBM 705 couldn't be run on Remington Rand Univac. It would be like trying to communicate with a Frenchman in Chinese.)

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an EYE

for Defense

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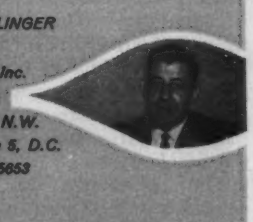

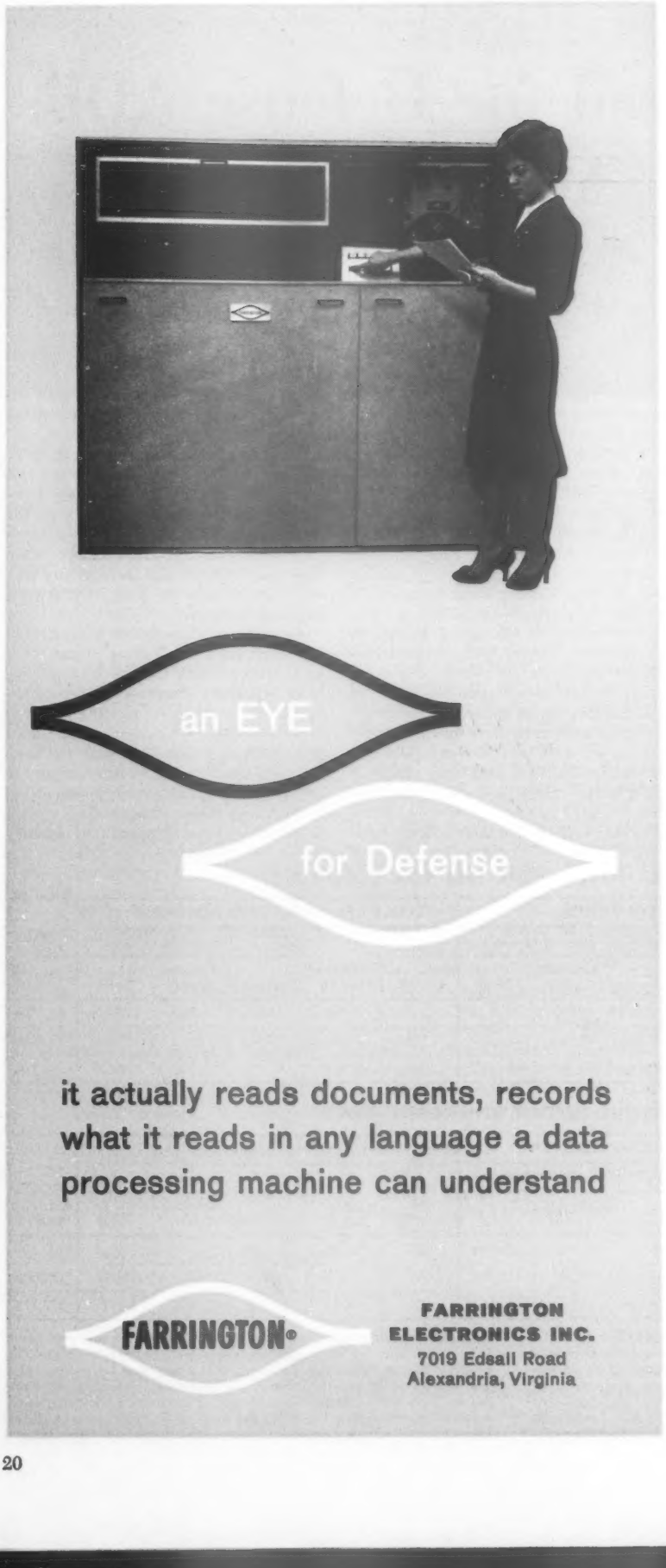
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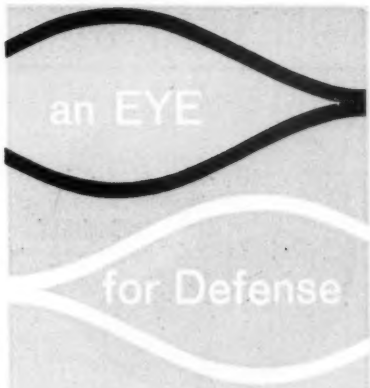
When CODASYL started out, they began doing things almost immediately which most experts would have said were impossible. For instance, they constructed the first COBOL specifications in six months, are putting out a revised edition sometime this month in which they think they have taken all the ambiguities out of the language. What was little more than just a sound idea two years ago is now something Defense at least knows works.

But developing COBOL hasn't been all that easy. There have been creaks, groans and complaints, many of them understandably from manufacturers. Some controversy persists even today. Example: because COBOL is necessarily a compromise (just as speaking to an Englishman in the much-publicized universal language is not quite as effective as talking to him in English), machine language loses some of its efficiency. Phillips' answer: "COBOL



The Farrington Optical Scanner, sometimes known as the EYE, actually reads documents. Furthermore, the EYE records what it reads, in any language that a data processing machine can understand. The EYE reads names, addresses, amounts, account numbers, serial numbers, code numbers, and plain text.

The EYE reads invoices, cash stubs, messages, order documents, journals, and checks.

Data for the EYE to read may be recorded by adding machines, imprinters, tabulators, typewriters, and high-speed printers, without the use of special inks or special papers.

Data which the EYE has read may be recorded on paper tape, punched cards, or magnetic tape.

Whatever the EYE reads, you read too . . . but the EYE reads it much faster.

Farrington Optical Scanners are already providing the answer to many big data-input problems in daily government and business operations. The answer is simple and economical, too, because ordinary documents become machine-processible records . . . processible, that is to say, by the Farrington EYE.

If you want more information about the EYE, or if your data processing or communications group needs an EYE-opener, contact:

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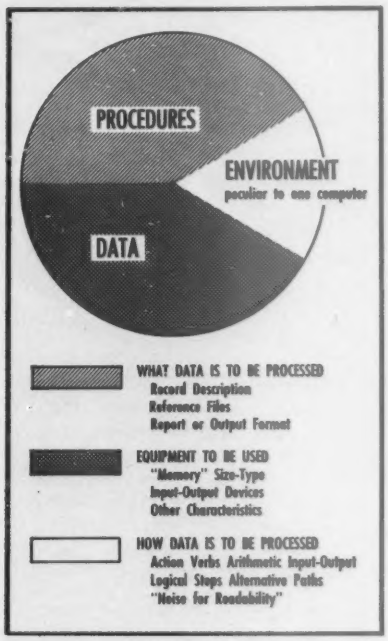
COBOL—What's Involved . . .



still attains 80% of the efficiency of programs written by top programmers in a machine's own language. And that's high enough to make COBOL easily as efficient as programs written by average programmers.

"Further, it cuts programmer training time in half. Moreover, it forces a discipline we have needed for a long time; to write programs in a standard form, language, etc.—an advantage just in source program exchange alone. Far too often, even today, we find that a program written by one top programmer can't even be understood by another one, mainly because of the past lack of this discipline."

But the most significant advantage, as COBOL experts see it, will be to top management. Because COBOL uses English language words to hand out instructions, top management can understand the language, can obtain, for the first time, a clear indication of whether the machine is being told correctly to do what top management wants it to do. It halts a trend which was threatening to slow down top management acceptance of computer. The trend: program technicians were getting between the computer and the manager, without COBOL, had no choice but to place implicit trust in the efficiency of his programmer and if the system burned him a few times he than had little choice but to distrust the whole system.

The advantages to management are being pushed hard by several manufacturers. Best rundown came from RCA recently in a brochure it put out on "Seven Benefits for Management From Plain English Programming." The advantages: less programming time, reduces training expense, establishes inter-computer compatability, speeds conversion to computer, expedites reprogramming to new EDP system, protects investment in improved processes, and lets management keep tabs on progress.

The main savings, in time and cost, amount to a lot of sheckles for Defense. If half of Defense's anticipated $313-million costs per year go into system design, flow charting, coding and debugging, at least half of that half (the coding and debugging operations) can be streamlined by COBOL. And experts are already predicting that of that $75-million approximately, COBOL will save a minimum of $20-million a year.

"COBOL has one other vital aspect," says Phillips. "In case of attack, and the possibility of a computer's destruction, vital as they are to Defense operations today, COBOL means we can still use the program, needn't spend a lot of time re-writing the program, from one piece of hardware to another located some place else."

He cautions however that COBOL is not 100% convertible from one machine to another, doesn't answer all the problems. The least compatible is the environment portion of the programming procedure (see chart). "This part," says Phillips, "is the one that needs specific equipment application but fortunately it is only a small part of the process (about 15 to 20%)."

Sums up Phillips: "our efforts in the past year have been remarkably successful, particularly when you consider that COBOL is the product of a spontaneous and voluntary effort. Major credit for results so far must go to the extremely cooperative spirit displayed by the computer manufacturers and their fine support of the effort. The ultimate and long range success will also be due to a continued cooperative effort—this time between the merely convert it in quick easy steps users and the manufacturers."

Result of all this COBOL effort: more and more people are getting on the bandwagon (or "taking the oath" as Phillips calls it) and as they do they almost invariably become more and more enthusiastic about COBOL's potential advantages to management in the use of computers.

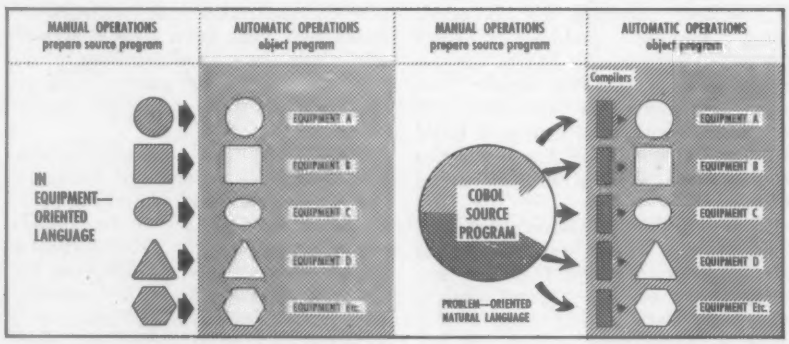
And the importance of the Defense-fostered COBOL can be appreciated when played against the future of the whole data processing field. Data processing expert James D. Gallagher said, of ADP's future, recently, "there will be continued rapid advances in the design and manufacture of EDP equipment and there will be an ever widening array of both general and special-purpose devices concerned with every aspect of data handling. Large computers will become larger, faster, more expensive and more efficient per unit of work handled.

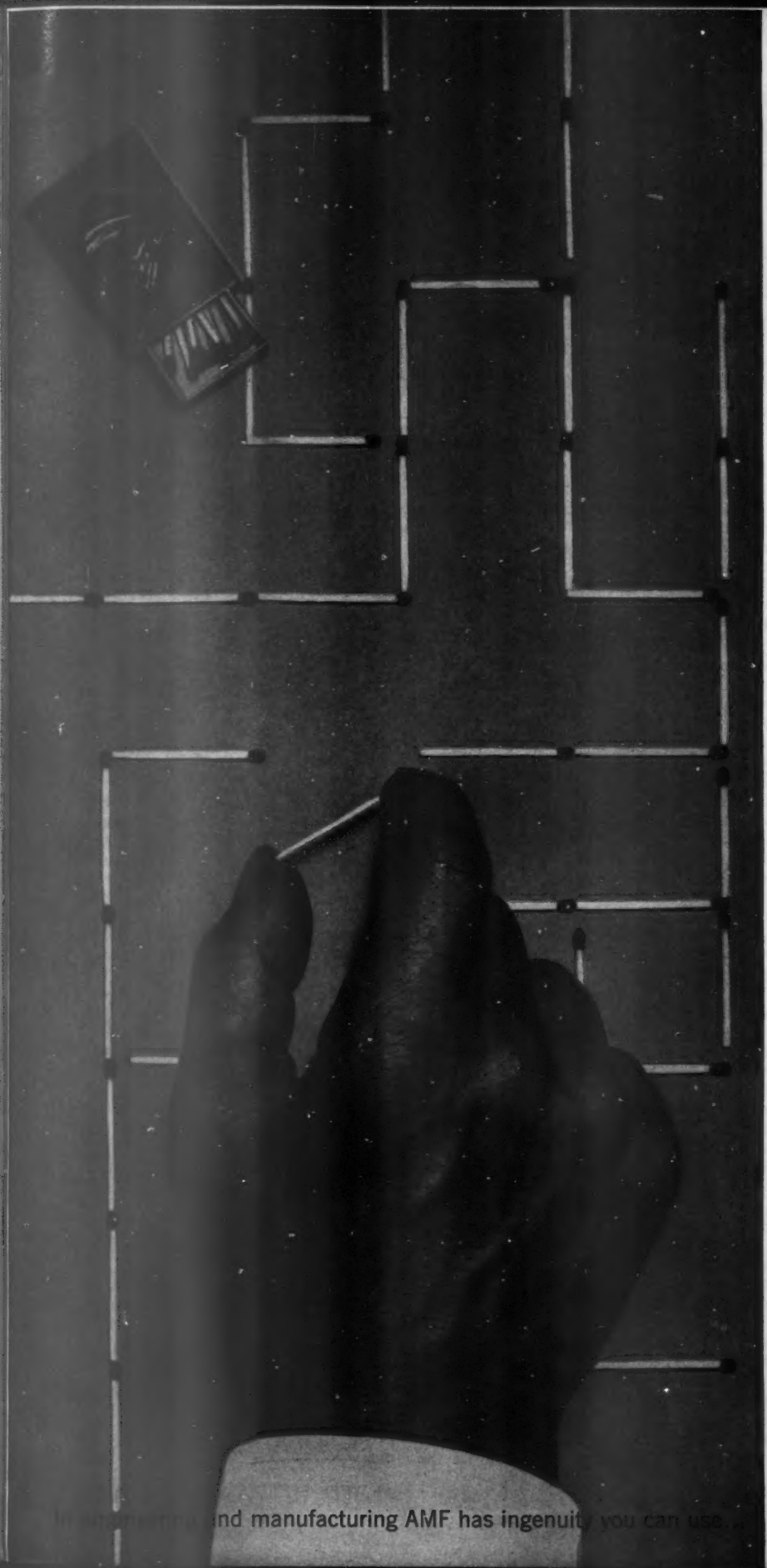
"Those who see only these developments will be impressed with the inevitability of super-centers for data processing. But small computers will become better and more efficient, and those philosophically attached to centralization will take comfort in these developments.

"Some of the most dramatic technical advances will occur in devices for getting information to and from the computer itself."

But, lest anyone get the idea that eventually the computer will do the whole job, Gallagher comes back to one important point, constantly emphasized in the past by everyone who has learned what computers are really all about. The point: "finally, management (has already) learned that in one important respect data processing is exactly like any other business function—the single most important determinant of success is the capacity of the men who manage it." ■

How COBOL (right) Improves The Old Programming System . . .





He designed a new interchange for radio traffic

This AMF engineer, part of an AMF-U.S. Army team, solved the problem of traffic delays and personal danger in manual re-connection of jumpers when interchanging R.F. transmitters and antennas.

His solution is a push-button-operated, coaxial crossbar switching system, using vacuum switches for circuit selection. A typical system consists of 4 transmitter inputs, 7 antenna outputs plus a dummy load, in a 4 x 8 matrix that can be mounted in a 19" rack. It can be controlled locally or remotely over any type of communication network having a bandwidth of at least 200 cycles.

AMF's coaxial crossbar switching system provides 100% flexibility in circuit path selection and accommodates power levels as high as 500,000 watts and frequencies up to 30 megacycles. It allows 100% utilization of all transmitting equipment. Stubs are automatically eliminated.

To insure fail-safe operation, power is required for the vacuum switches *only* during change of condition. Selection rate: 1 per second. Operating transmitters are safety-interlocked to insure a load. There are no hazards from open wires or inadvertent application of power to dead-lined antennas.

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Pentagon Profile / **Captain Edward C. Svendsen**
NTDS Special Projects Officer

Can "Special Projects" Be Routine?

AMONG MILITARY DECISION makers on the business side of the operation, one debate in the past few years had consumed probably more verbiage than all the other military management problems combined. The subject: what is the best way to apply the Nation's defense-industry team resources for most effective (and quickest) development of new hardware?

In one form or another, the debate has led to drastic organizational shake-ups, vitriolic Congressional inquiries, and whole new languages ("weapon system," et al). And clearly, at least so far, the question has no pat answer.

But just as clearly, debaters have tended to choose up sides—either (1) stay within the existing organizational framework or (2) if it's *that* important, it must be a "special project" cutting across traditional organization lines.

Rarely has military top management given any thought to the possibility that you could do both at the same time—except for a handful of Navy experts tucked away in room 3324 in Washington, D.C.'s weary Main Navy building. In fact, they claim they have been proving it for almost six years.

Headed by 44-year-old Navy Captain Edward Charles Svendsen, they have married the impressive capabilities of a total organization (Bureau of Ships) with the efficiency of "special projects" management to develop the Navy Tactical Data System, outlined elsewhere in this issue.

Started in 1955, NTDS has carried a number one Navy priority—and fought plenty of problems. An outgrowth of a study on sea extension of SAGE (the still-highly-classified Project Lamplight) NTDS was cranked up when computer development was on the threshold of a technological revolution. Moreover, putting a computer aboard ship to provide information for combat decisions meant tying together many types of technology: computer, radar displays, sonars, electronics, electronic counter-measures, etc.

Given priority and problems, NTDS had all the qualifications necessary for a special projects office. But the word came down that NTDS, drawing horizontally from several engineering talents, would have to solve its problems while staying within the bureau organization—which tends to chop projects vertically.

The Navy picked Svendsen to come up with the answer. A 1941 Naval Academy graduate (and football letter man), Minnesota-born Svendsen and spent most of his Navy career in and around some of the technological areas (radar, electronics) involved. He had one other asset: a computer savvy resulting from four years as technical officer in the Navy Computing Laboratory, St. Paul, Minnesota.

Svendsen moved into Main Navy in August, 1954, acquired a small staff. (Even today, the NTDS project staff is minuscule as military projects offices go, has only six officers reporting directly to Svendsen.) BuShips helped pick Remington Rand to do a component study in 1955, of the whole electronic industry, to see what would be best for the computer, had them do a system design and analysis.

Then, to draw as much as possible on the total resources of BuShips, Svendsen had picked key men in each BuShips division to work on NTDS. They still stayed in their own offices, still worked on other things—which allowed them to stay current with developments. But the bureau made it clear that their primary concern should be NTDS.

Further, to tie industry (Rem Rand and subcontractors) closely to the Navy side of the team, each contractor was given a contract in the bureau branch concerned with his area. The contact wrote specs and procurement regs (all approved by the NTDS project office, of course), saw that the contractor understood what they were all about.

Svendsen drew on two other sources for assistance. The CNO side of the Navy organization gave NTDS strong support in the budget battle, the attack on military red tape. And finally, the 130-man Navy Electronics Laboratory performed not only a running operations analysis but also acted as "an impartial buffer" against the validity (or potential lack of it) of Rem Rand R&D proposals.

Part of the glue that held the project together: asking Rem Rand to tie the parts into a package, do the computer programming. "In effect, we have given contractors the complete job and ask the lab to keep a critical eye on what they are doing, technically. If we handle it right, both sides of a problem will crop up in the projects office and can be resolved there."

Svendsen's basic decision: keep systems management within the Bureau of Ships, go to the contractors best capable to supply each of the parts. Says Rem Rand's Washington contact, Bob Nyvold, "the whole project would have fallen flat on its face if it hadn't been for the capability of Svendsen's Navy team."

Svendsen has no illusions about the pitfalls of marrying the special projects groups to the standard organization. Other segments of Navy bureaus, he notes, have tried this approach, frequently seen it flop. "It has worked here," says Svendsen, "because we have sharp people and they have worked their tails off. It has been a seven-day-a-week for all of us with lots of traveling, lots of meetings."

"Of course, to do the job at all, we had to solve the continuity problem. We have—by just keeping the people here." And, he adds, "I'm convinced, if you have the right people, this is the most efficient way to handle any large program such as NTDS."

"The only question we still haven't answered is just how large the monitoring staff should be. If it gets too large, we run into personnel communications problems. If it's too small, the staff is overworked." ■

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Available for the RCA 301 and 601 EDP Systems, here's what this new printer will do:

- Operate up to 1,000 lines per minute when printing 47 different characters.
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- Printing is done at 10 characters per inch.
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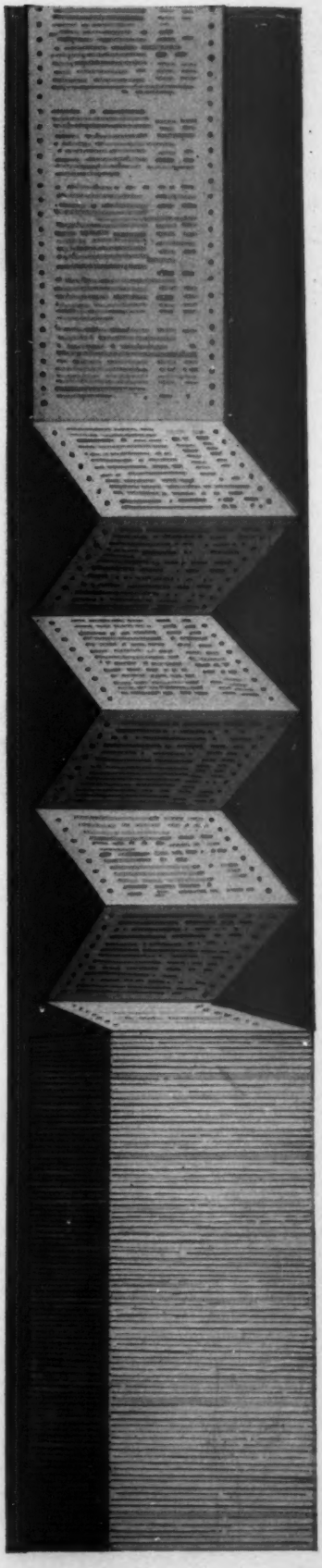


Garbed like surgeons, Hughes engineers and technicians assemble accelerometers in this "clean room." Here, the air is a thousand times freer of dust than an air-conditioned office. In fact you literally "taste" the clean air!

Accelerometers built in this room are so sensitive they can measure movements we cannot see. In missile inertial guidance systems they can sense acceleration of .003 of an inch per second per second.

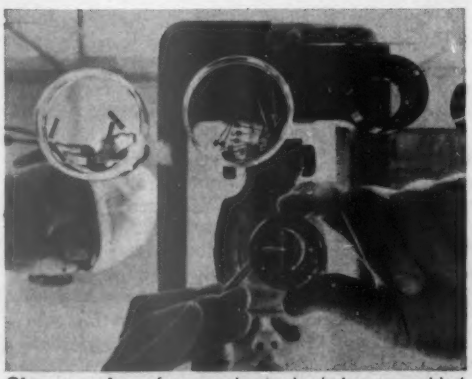
But a tiny speck of dust between their micro-finished surfaces could make them useless for the "mind" of a missile.

This type of accelerometer combined with gyroscopes and advanced electronics results in an inertial guidance system which is completely self-controlled—it cannot be "brainwashed." It needs no commands from the ground. It is invulnerable to "jamming" which might throw it off course.

Hughes is now applying its complete systems experience to all pertinent areas of creating inertial guidance systems: inertial components, computers, platforms, support equipment, advanced systems studies.

Hughes inertial guidance systems "marry" the latest developments in *both* electronics and mechanics. With this effort Hughes adds another facet to its broad scientific and production capabilities. This experience may be useful to you. We may have the answer to your problem. The result could be profitable for both of us.

be brainwashed



Close-up view of an accelerometer being assembled in the Hughes dust-free "clean room."

Creating a new world with electronics

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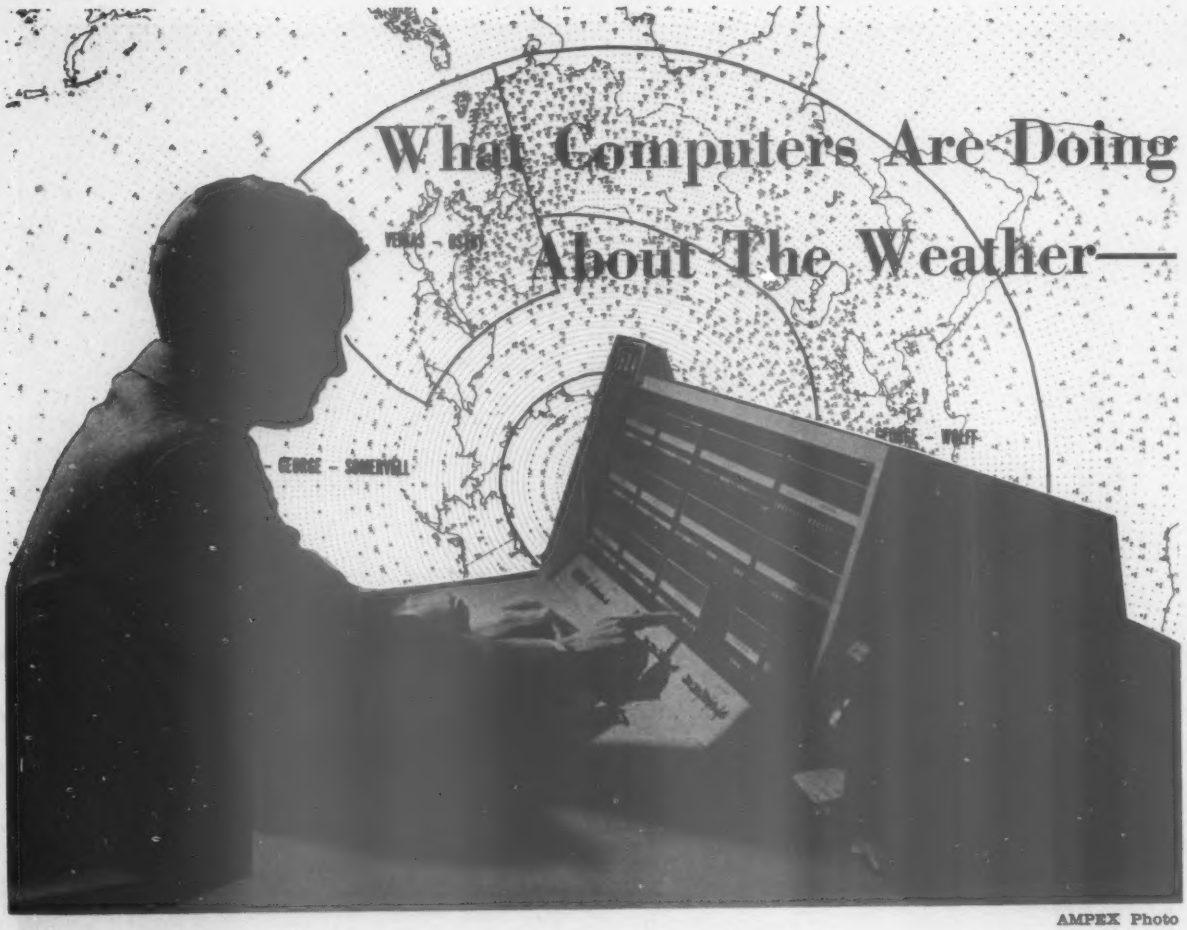
What Computers Are Doing About The Weather—



AMPEX Photo

When the Control Data Corporation's new satellite computer system goes into operation in the late fall, it will give the fastest answers ever to the problem that has plagued man for thousands of years—Mother Nature. This is what Navy's Fleet Numerical Weather Facility is doing in order to give instantaneous world-wide weather reports through use of advanced computer systems . . .

by Frank G. McGuire

USING A COMBINATION of traditional weather-predicting techniques, mathematical models and high-speed computers, Navy's Fleet Numerical Weather Facility (FNWF) expects soon to revolutionize the weather business. Its progress curve so far indicates that it probably will.

Housed at the Naval Postgraduate School, Monterey, Calif., FNWF became operational six months ahead of schedule this February, after six years of a multi-agency search for weather prediction methods more reliable than intuition. The facility's reports are now used as gospel by Pacific Missile Range, and within the next year, FNWF will begin predicting weather on an hourly basis for ten Navy bases around the world with reputations for being upredictable.

Commander Paul M. Wolff, Officer-in-Charge of FNWF and a moving force in its birth, says agreement between computed conditions and observed conditions is excellent. Even more detailed predictions are looked for in the near future, with high confidence levels.

Present predictions, covering the entire northern hemisphere, are for a 200-nautical-mile-square grid, and will soon be improved to areas as small as ten miles square. The computing equipment, using raw data from on-the-spot weather stations reporting immediately-past conditions, predicts wind velocity and direction data to great accuracies (four or more decimal places!) but FNWF rounds velocities off to the nearest knot.

Extrapolations allow data to be forecast for areas where there are no weather stations or observers, and even —as someone put it—where the observers wish FNWF would mind its own business.

Agencies interested in FNWF in-

clude Strategic Air Command, U.S. Weather Bureau, Naval Research Laboratory, Bureau of Naval Weapons, Pacific Missile Range, Australian Weather Service, and numerous others.

Current utilization of about fifty hours weekly is being realized by FNWF with its equipment estimated at about $1-million in cost. Next major step in improvement is full commitment to the Control Data Corporation's satellite computer concept, which should be in full operation by late fall. The concept allows greater flexibility, boosts speed and accuracy, and allows greater coverage of operations.

To accomplish its assigned mission, FNWF has twenty military men and twenty civilians. Forty men are doing a job usually requiring over 100, and at a much lower cost and at a greater speed.

FNWF began life in July, 1958, as NANWEP (Navy Numerical Weather Problems Group) which in turn was an offshoot of a Joint Numerical Weather Prediction Unit (JNWPU) sponsored by the U.S. Weather Bureau, Air Weather Service, and Naval Weather Service.

Mission of FNWF is twofold: To provide operational numerical products; and to develop and test new computer techniques in meteorology. For its job, accomplished under the management control of BuWep, FNWF has had less than $1-million total budget.

System Equipment

The Navy facility is presently based on a Control Data Corporation 1604 computer coupled with a smaller model, the 160—soon to be replaced by 160A models. Constant improvements in equipment and techniques are taking place, with a resulting sharp rise in product quality. Seen at a quick glance, the entire system, as it stands now and is eventually foreseen, appears to be a complex of computers talking to computers, teletype links, cross-country circuits, plotting machines and spinning magnetic tape reels. It is!

The final product, however, is produced by 40 men instead of the more than 100 a conventional weather station would require for the same job, and is turned out in minutes.

Weather charts drawn by the present FNWF equipment appear to be someone's attempt to draw a map of the entire northern hemisphere with a typewriter. They are, but they make sense because they are highly accurate representations of pressure areas, are quickly produced, and quickly translated into pressure patterns on standard weather charts. FNWF will soon eliminate this hand-translation process by feeding the 1604 output directly into new 160A computers to run plotters which will produce a finished weather chart.

AMPEX Photo

Two men of the Fleet Numerical Weather Facility prepare a weather program for the FNWF Control Data Corporation 1604 computer. In the background are the magnetic-type recorders.

Soon to undergo a series of changes to greatly enhance its performance, the FNWF now consists of the following major elements: six teletype circuits feeding into a data communicator which reduces input to magnetic tape for use by the 1604 with the resulting prediction being fed into a printer for semi-final map to be translated to weather chart.

When planned changes are complete this fall, the data communicator will be used as backup for a CDC 160A which will read all six teletype circuits simultaneously and give the reduced information to the 1604 in one slug. After predictions are made, the answers are fed back into the 160A computers for transmission to remote weather centers, freeing the 1604 for more important work. And allowing a reduction in cost.

Subsidiary Tasks

During the 1604's efforts at making predictions and analyses, both 160As are used for subsidiary tasks. All computers will have access to a central tape unit containing all pertinent information. The 1604 monitors and operates the complete system, with each satellite 160A computer free to enter the system or leave it for optimum economy and efficiency. Maximum number of 160A satellite computers which could be used with the 1604 is six. FNWF will use two.

Another change expected to increase speed and accuracy is the bypassing of hand-drawn final maps from the semi-final printer maps composed of numbers. Plotters will take the output from the 160A and produce a finished weather chart directly. The 160As will transmit data to the other 160As at weather centers planned for operation around the country (The first will go into Suitland, Md., this fall.)

Prediction Process

After teletype data is reduced by editing, eliminating redundant and other unusable reports, and insuring consistency of terminology, a weather map of current conditions is prepared with a 205 n.m. square grid. The map covers the entire northern hemisphere and after grid intersections are assigned an address, weather reports from nearby stations are introduced with interpolations to provide a pressure value for the intersection.

A pattern of ever increasing circles is used to peg those intersects with few or no nearby weather stations.

The computer then predicts pressure changes at each grid intersection as a function of time, based on proven mathematics, extending to 24 or 48 hours in advance. The process involves an estimated 50 million computations, and from acquisition of teletype data to finished weather chart consumes about a half hour.

As the paper issues from the printer, it is covered to varying degrees with numbers, representing pressure patterns. One numeral, for example 7, is used to shade an area of constant pressure, while the pressure reading for the area is printed at its grid intersections. Viewed casually, the sheet seems to be a meaningless clutter of

digits forming various shades of gray.

When a FNWF meteorologist places an acetate overlay on this pattern produced by the printer, however, he traces the edges of these constant pressure areas—producing a weather chart on the overlay, which is printed with a northern hemisphere map with appropriate grids. Transmission of the chart is then possible by facsimile to fleet and shore stations. Those unable to wait for the map transmission can receive the numerical data pattern via teletype and make their own maps.

It is this hand-transfer of pressure lines which will be bypassed by fall.

Advantages

"Weather men, when modifying our machine-product to fit their experience, usually worsen it . . . and occasionally improve it," commented Lt. (j.g.) David McIlhenny, developer of many FNWF computer programs and equations. Navy prefers to let its computers have their own way, based on this, but emphasizes that the entire operation is still a combination of traditional techniques and computer techniques.

FNWF is very happy with the CDC equipment because of its ease of programming, operation and maintenance, and its low costs. As of right now the facility can't do much with such subtle conditions as coastal fog, but the improvements slated for completion this fall are expected to provide more detailed information and hence allow computation of such phenomena.

Accuracy of predicted sea conditions obtained from the equipment is excellent and is much more so than can be accomplished manually. Detail is increased due to the difference of 700 hand entries per chart obtainable against several thousand by computer-printer. A typical sea-condition chart for the northern hemisphere can be completed in about 12 minutes.

Applications

Originally sent to Pacific Missile Range headquarters at Point Mugu for evaluation against observed conditions downrange, FNWF weather charts were soon in operational use because of their value. At 0330 each day, FNWF begins transmission of 18 northern hemisphere charts, at 35 seconds transmission time per 1977-point chart. Data gathering and processing for these charts begins at 2300 the preceding night.

The system transmits data directly from the core of the CDC 1604 computer at Monterey to the core of the IBM 709 computer at Point Mugu. The receive program at Pt. Mugu was written by Land-Air, Inc., and is being updated along with the rest of the system. When the satellite computer concept is in full operation at FNWF, the CDC 160A computers will feed data to the Pt. Mugu facility.

Resulting high-quality charts will allow greater confidence in missile scheduling on PMR's downrange operations.

In more prosaic operations, ship scheduling will benefit greatly through optimum use of sea-condition charts. A task force will be able to skirt the edge of bad weather, taking advantage of it or avoiding it completely. Vessels with deck cargo can plot the easiest course compatible with time schedules.

Typical of specific data provided by FNWF, in this case to PMR, is the sea condition analysis, including wind-generated wave height, direction and period, as well as analysis of the highest swell, its direction and period.

The computer program for this particular compilation and prediction is undergoing an overhaul to provide more computer storage space and reduce running time.

Another specific program is an analysis of ocean temperatures at 100-foot depth intervals, results of which could be of immense value to U.S. submarine and anti-submarine forces. Area chosen for study is a section of the eastern north Pacific, with depths up to 400 feet programmed for study.

Evaluation

Not confined merely to oceanographic weather studies, FNWF is using three empirical systems for forecasting cyclones. The three systems will eventually provide methods of detecting and forewarning of cyclone-producing conditions between 20 and 70 degrees north.

Upper air analysis charts include information on hemispheric height and temperature analysis for the 1000 millibar, 850 mb, 700 mb, 500 mb, and 300 mb levels.

Operations conducted thus far have demonstrated a high degree of reliability in accuracy—over 90%—and in one instance, the figure was almost 100%. FNWF says only one case of data mishandling has been discovered in three months.

Sea and swell analyses have been excellent except when data input was faulty, with the only discrepancy being an excessive reading for wave heights near shore when a brisk off-shore wind is blowing.

Overall, FNWF is extremely encouraged by its progress, its equipments' performance and the results obtained thus far. The future of numerical weather forecasting techniques looks bright, especially since it is feasible with low-cost, easily-used equipment, with speed quite capable of handling the job. ■

Combat Computer

(Continued from page 15)

judgment on control of the ship, assignment of weapons, and coordination of the task force.

Also contributing to the development of the NTDS were Hazeltine Corporation for displays, Manson Laboratories, Daystrom, Inc., and Western Electric for data link equipment, and Cornell Laboratory, Inc., for special studies.

The big impact on the NTDS will be among the Navy's operational personnel. The Navy points out that the system can be programmed to emphasize air defense, anti-submarine warfare, or surface warfare—or a combination of all three. It can be converted from one to the other without any major change in the NTDS hardware.

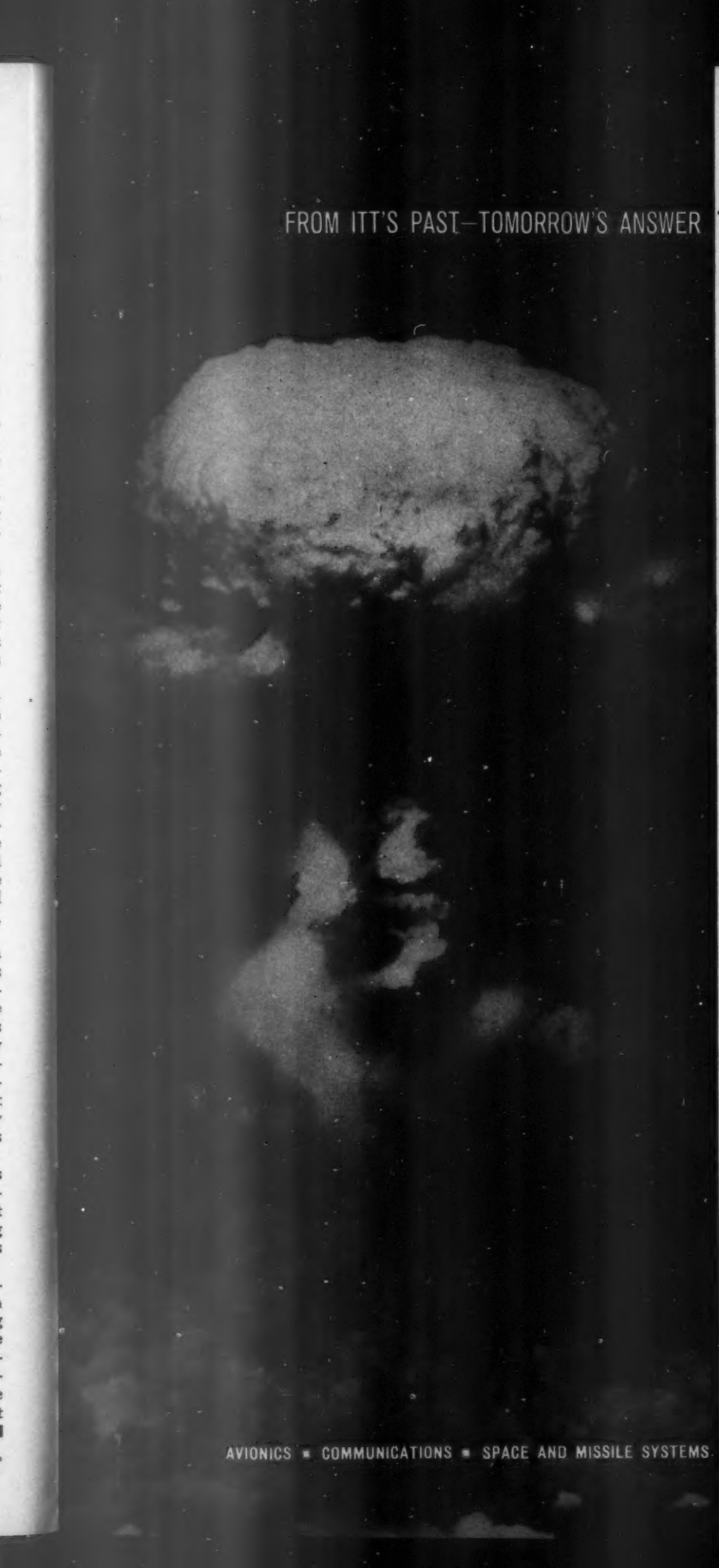
Command and control requirements are extremely difficult to spell out, it was explained, but with NTDS the entire combat direction system will not have to be rebuilt as a result of changes in other systems aboard ship such as missile control systems.

Each ship may differ in such equipment as radars and the fleet cannot be altered overnight, one of Capt. Svendsen's men said, but NTDS fits into the evolutionary process and its components are adaptable to the changing requirements. As an example, if a new aircraft interceptor should be introduced, the computer would have to be reprogrammed for its rate of climb and other characteristics, but no hardware change would be necessary. "Instead of changing the hardware," he said, "we change the program."

As in all other Automatic Data Processing developments, the success of NTDS depends on the use of appropriate computer programs under the control of skilled operators. To this end, some 35 Navy officers are now assigned to the Navy's interim programming center at the Naval Electronics Laboratory where for the past year they have been working closely with civilian analysts and programmers furnished by Remington Rand.

Current plans call for moving this programming team into a newly constructed Fleet Programming Center at the Fleet Anti-Air Warfare Training Center, San Diego, sometime this summer.

Additional officers and enlisted personnel who will operate and maintain the NTDS aboard ship are being trained at Great Lakes, the NEL, the Fleet Anti-Air Warfare Training Center, and the contractor plants. Eventually, the training program will be extended to a maintenance school at Mare Island. ■



FROM ITT'S PAST—TOMORROW'S ANSWER TO

COMMUNICATIONS UNDER ANY CONDITIONS

Consistent with its policy of thinking and working years ahead, ITT Federal Laboratories has been concerned with the communications problems which might arise in extreme emergencies. That, surely, is when the need for rapid interchange of information would be greatest, and where the system and equipment would have to be absolutely reliable.

Providing airborne guidance and communication systems capable of outstanding dependability under even the most unfavorable environmental conditions, is a significant aspect of ITT's past and current record. Instrument landing systems, direction finders, distance measuring equipment, and guidance systems for some of our most successful missiles are but a few of ITT's developments in this field. Today, Company-sponsored research activities responsible for many of these accomplishments have been greatly expanded to anticipate the increasingly critical communications needs of the future.

To the military and to industry, ITT Federal Laboratories offers a unique combination and continuity of skills, already existing as a highly trained team, for performance of complex projects throughout all stages from original concept to the delivered system.

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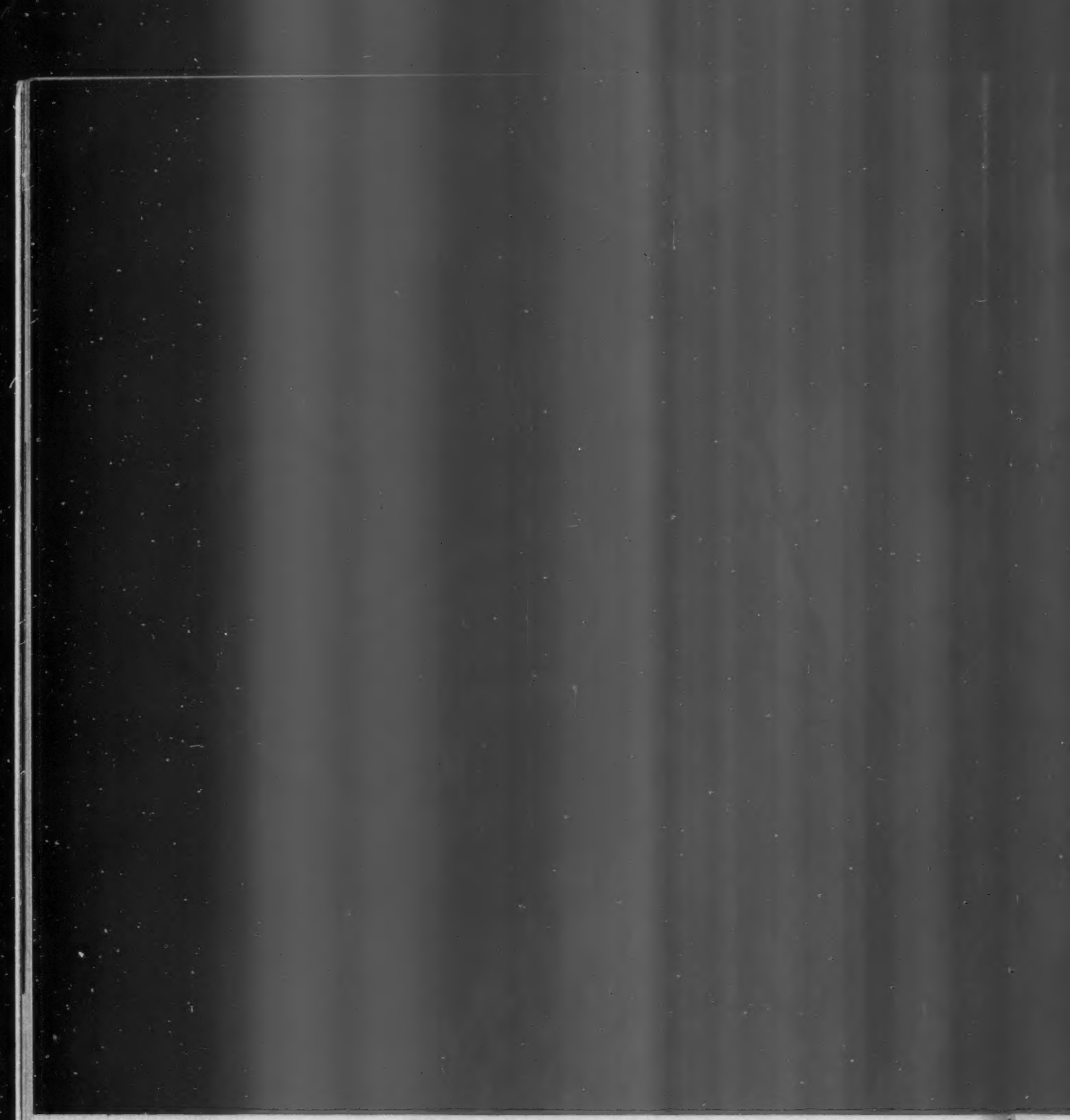
DIVISION OF INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

AVIONICS ■ COMMUNICATIONS ■ SPACE AND MISSILE SYSTEMS ■ **ELECTRONIC DEFENSE ■ PHYSICAL SCIENCES**



When disaster threatens, the call goes out for the Lockheed C-130 Hercules. TAC's C-130s airlift men, material, medicine to distant lands to help homeless or hungry people—or put out brushfire wars before they spread. Converted to fit Forest Service needs, the big bird can rush heavy loads of fire retardants and firemen to timberland hotspots and save our natural resources. There's practically no limit to the airlift jobs Hercules can handle. Lockheed Aircraft Corporation, Georgia Division, Marietta, Ga.

LOCKHEED GEORGIA

Is Management Ready for ADP?

Computers can solve problems, but also have the capability of creating others. Unless managers are aware of possible pitfalls, they may expect more headaches. Many means of making the best maximum use of ADPS are available. One of the keys to success with the system is continuous feedback reporting on the usability of the computer's output.

Paul J. Hyman
Defense Directorate
Supply Management Policy

THE PRESSURE OF CONDUCTING ADPS feasibility studies, selecting hardware, analyzing data flow, preparing programs and training personnel both in and out of the machine room, is just the beginning of management's problems in using electronic computers for business data processing.

After the new electronic data processing system is installed and is generating planned outputs, management usually finds itself facing a new set of problems.

In order to use the full potential of expensive ADPS, managers find they must devote continuous attention to the data processing system. The size of programmer staffs seldom diminishes after a large program has been debugged and placed on a computer.

Members of line organizations who have been assigned to developmental tasks of installing a data processing system, may return to their jobs away from the machine room, but they find themselves continually engaged in problems of system maintenance.

Feedback Necessary

Military activities employing large scale data processing systems for inventory management have found that system maintenance is a continuous task requiring the feedback of information on system performance and the weeding-out of procedural inconsistencies. In solving these problems, most organizations are developing a core of capable specialists in information systems analysis. These information technicians will play a key role in exploiting the full potential of installed ADPS.

A good deal of the data processing system maintenance in military supply installations is generated by the dynamic nature of changing Defense programs, but many businesses are subject to similar problems of changing markets, limitations on resources and other constraints on management.

For managers who are about to install ADPS, the experience discussed here should be a portent of things to come, after the equipment is installed. For those readers in an organization now with ADPS, the experience related here should provide a basis for comparison.

The analysis of the flow of information within an organization does not stop when the computer is installed and commences to print out reports. Data output which is sent to inventory analysts and operating managers for use is often unusable, is not relevant to the real management data requirements or is poorly presented.

Old Records

Even in situations where employees outside the computer room or ADP directorate have been given adequate education on the use of computer products, machine printouts may be rejected and old record keeping methods continued. In some cases, "bootleg" manual records have been found in use one year or more after installation of an ADPS.

To avoid these situations, there must be a continuous flow of information between programmers and managers on the use of computer products. In many cases the program must be revised soon after computer installation to be more responsive to the needs of management.

In several inventory control applications, supply analysts have been found rejecting computer produced recommendations to replenish or to dispose of inventories. Analysts were found manually re-computing or adjusting quantities recommended by the ADPS. In most instances the analyst had access to data which was not available to the ADPS; he may have had more current data on procurements than the ADPS file maintained.

One system continued to print-out recommendations to procure obsolete items and the analysts naturally disregarded these computed recommendations after brief manual research. In time programmers were able to prevent such unnecessary print-out.

Since it is common to find many growing ADPS installations spending energies planning future applications while existing programs still require remedial programming, the demand for programming and systems analysis skills grows long after the initial computer arrives. Too often, time for remedial programming or reprogramming is under-estimated in planning for new ADPS.

Programmers and system analysts must be informed of their programs' successes and failures. A system of continuous feedback reports on the usability of computer output is an essential mechanism, for the critical and timely evaluation of the effectiveness of a program. This feedback is essential for the intelligent maintenance of programs which is so often overlooked in planning for ADPS.

In connection with one Air Force weapon support system, with input prepared at bases around the globe and with the program centrally developed and run on large scale ADPS at several locations, a formal procedure of Deficiency Reporting has been established. A standard format is used to report program hang-ups and suggested improvements in prescribed operating procedures. With this Deficiency Report corrective action may also be recommended to improve the usefulness of data out-put or to recognize the need for additional products.

New Reporting

Communications has long been a problem in organizations, so that an effective feedback may require establishment of new channels of reporting. Liaison must be solidly established if a central data processing organization is to service customers satisfactorily. In large scale data processing systems, this feedback mechanism becomes a key element in getting the most return on ADPS rental expenses.

The growth of large scale data processing systems, often linking several medium size computers in remote locations with larger equipments, has

presented problems which are new to the top management level. These problems have become increasingly more evident with the growth of data processing systems, and since they prevent the effective operation of large data processing systems, more and more management thought must be devoted to them.

The problem of procedural coordination has now become a flourishing management concern. The development of large ADPS has made management realize how costly it is to have inconsistent procedures at different locations.

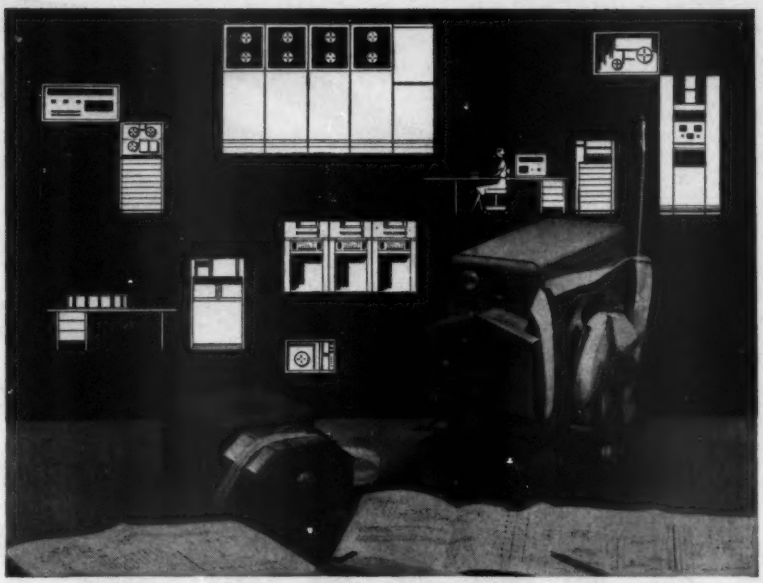
With the installation of computers at Army supply depots and at inventory control points around the world, it was found that punch cards prepared at one depot were not suitable input for other data processing systems. Card layout was different. The Quartermaster system allowed 11 digits for the stock number while Engineer forms required 19 digits. Data field alignment became a major factor in complicating sorting operations and increasing costs. Ordnance Corps formats allowed 8 digits to indicate the quantity of an item while records in other logistical services used various smaller data fields.

Standard Formats

The Department of the Army was forced to develop a standard format for the most commonly used supply system forms; there are over 100 million requisition cards consumed annally. The job of developing and maintaining codes to be used in standard mechanized forms has become a full-time job in the headquarters of many organizations employing ADPS. And rightfully so, for central direction is required from top management or some operating group working with the authority of top management.

Top management must be prepared to step in and resolve discrepancies in systems and procedures. Data processing systems require a higher level of coordination on procedural administration than management has been prepared to assume in the past. With the growth of ADPS, policy makers are often finding themselves concerned with procedures.

In short, management's preparations for the installation of an electronic computer serves as the foundation on which the ultimate business data processing system will develop. As systems grow, management must be prepared to recognize and reconcile procedural differences which prevent efficient systems integration. To develop and preserve the data processing system, management must organize a feedback mechanism furnishing a constructive analysis of the usability of data processing by the ADPS. ■



New Teletype 1000-speed tape units

Here are two new units that offer the advantages of punched paper tape at 1000 words per minute—and combine traditional Teletype dependability with design simplicity and relatively low cost. Used together, the CX reader (left) and BRPE punch (right) are ideal for tape-to-tape communication of bulk message or statistical traffic via the new Data-Phone service. The reader and punch may also be used individually for communicating data to or from computers, and other devices associated with data processing, telemetering and similar communications functions.

These high-speed units operate on a parallel-wire signal path, in either transistorized or vacuum tube circuits. For serial transmission over conventional voice channels, signals can be converted by external facilities. A pulse generator, adjustable through a full 360 degrees, triggers the external signal storage and provides optimum synchronization of intelligence transfer.

Tape Reader—Will read chadless or fully perforated tape, in 11/16", 1/8" or 1" tape widths. Includes a set of auxiliary timing contacts that operate simultaneously with the sensing pins and assure accurate synchronization with associated transmitting equipment. Dimensions: 5" high, 6" wide, 11" deep. Models available for reading 5, 6, 7, or 8 level codes.

Tape Punch—Produces fully perforated tape. Equipped with "low tape" warning mechanism which can be wired to external alarms. Tape container designed for easy access. Dimensions: 12" high, 8" wide, 16½" deep. Available in two models—one for punching standard 5-level communications code (11/16" tape); the other adjustable for punching 6, 7 or 8 level codes (1/8" or 1" tape).

Teletype Corporation manufactures this equipment for the Bell System and others who require the utmost reliability from their data communications facilities. For free descriptive literature on the CX and BRPE units, write Teletype Corporation, Dept. 77G, 5555 Touhy Avenue, Skokie, Illinois.

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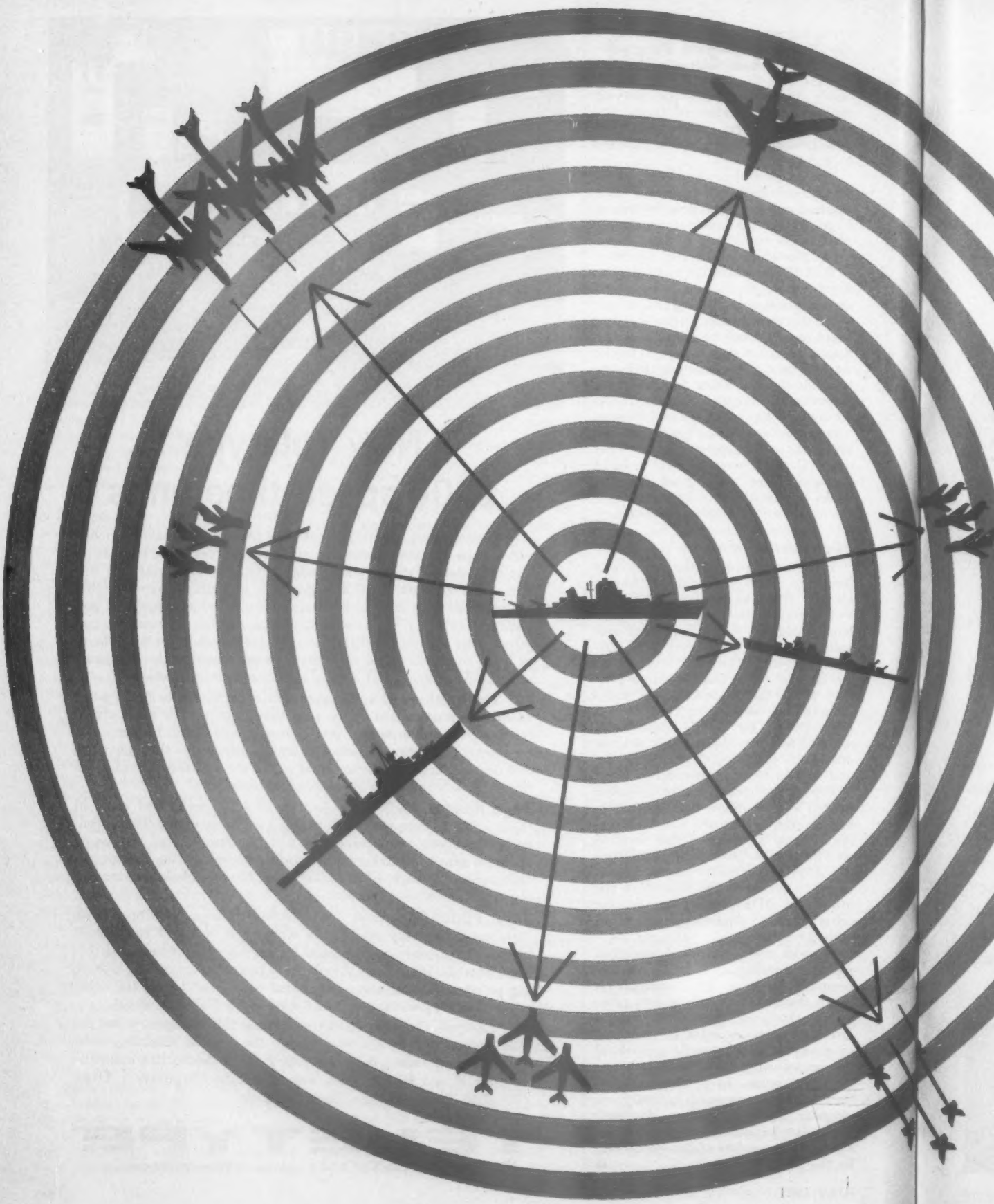

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A Fleet Weapon System Development Providing Round-the-Clock Protection

Advanced capabilities in system engineering at Westinghouse are bringing a tremendously powerful new shipboard weapon control system into being for the Navy. This vital part of the TYPHON weapon system soon will enter the test phase.

When developed, the TYPHON weapon system will provide the fleet with greatly improved defenses against enemy airborne weapons, plus longer range attack capabilities. The system is designed to simultaneously handle a larger number of targets than ever before possible.

Heart of the TYPHON system will be an advanced, long-range search, track, and missile guidance radar that will be designed, developed and produced by the Weapon System Department of the Westinghouse Baltimore Defense Divisions, under prime contract to the Bureau of Naval Weapons. The TYPHON program is under the technical direction of the Applied Physics Laboratory, Johns Hopkins University.

Westinghouse contributions to TYPHON are the result of many years of experience with such basic elements as radar, computers, airborne guidance and control, and search and tracking systems.

TYPHON is another demonstration of how science and systems engineering capability are serving Defense at Westinghouse.

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Each CRAM file controls a deck of 256 magnetic cards capable of storing over 5,500,000 alpha-numeric characters. Information stored on the cards can be directly addressed for high-speed random or sequential processing.

What are its advantages?

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Learn how CRAM can benefit you. A specialist in Federal Government data processing requirements will be happy to discuss National's services and full line of equipment with you. Contact the Government Sales Division, 1217 "K" Street, N.W., Washington 5, D.C. STerling 3-3335.

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Research Rundown

White House R&D Control Urged

Creation of a new "Office of Science and Technology within the Executive Office of the President" has been recommended in a staff study of the Senate Subcommittee on National Policy Machinery headed by Senator Henry M. Jackson (D., Wash.). The study further recommended that the new office be directed by the Special Assistant to the President for Science and Technology and that this post together with the Science Advisory Committee be made permanent parts of the Government by statute. Jackson endorsed the recommendations with the statement: "We must bestir ourselves, lest Sputnik and the Cosmonaut mark only the beginning of a long list of Soviet first, and lest we fall short of our best in putting science to work for peace and welfare and individual freedom."

Other Jackson recommendations: the new office should improve coordination of agency science programs by serving as technical counsellor to the President and the Bureau of the Budget; the office would be able to give Congress data on the Government's scientific activities from an overall, rather than departmental point of view; and technical scientific staffing should be strengthened in the State Department which currently does not possess in-house technical competence.

New ADPS Shaves Milling Lead Time

Reduction in lead time from three months to two weeks in the production of complex heavy machine parts is forecast through use of a new computer program designed for milling surfaces in three-dimensional shapes. The process was developed by the International Business Machines Corporation and employs a new computer language to describe and automatically guide the tool paths of the tape-controlled milling machine. In a recent demonstration on the production of a complex helicopter gear box cover, the computer's instructions enabled the milling job to be completed in one-fourth the machining time required to mill a similar part conventionally.

Air Force Studies Molecular ADPS

The Air Force is researching a molecularized computer with the same capabilities, but only one-tenth the size and weight, as the transistorized computer. By using molecular electronics, miniaturization is achieved by the elimination of tubes, transistors and resistors. Substituting for these items is a solid semiconductor crystal which functions through rearrangement of its internal structure to form molecular blocks.

One research and development model is designed to weigh about 15 pounds and occupy about one-third of a cubic foot. This compares with a similar transistorized computer weighing 175 pounds and taking up three cubic feet of space.

New Voice System Gets USAF Tests

Also under evaluation by the Air Force is a revolutionary development in voice and data communications. It consists of a mobile, private radio telephone system that requires no wires or central switchboard, and can be used for air-to-air, air-to-ground, and ground-to-ground applications. With the new equipment, a subscriber can dial any other subscriber and talk privately with no interference. Six of the units have been purchased by the Air Force from the developer, the Martin Company, for tests.

The private conversations are accomplished by a modulation technique which carries voices simultaneously between many persons and locations in the form of quick pulses of radio energy on a single frequency band. The speech signals are disintegrated and coded into millionth-of-a-second fragments, combined at random, and all are transmitted immediately over the same channel. The coded circuits are dialed manually to match those of specific receivers and only those receivers which are pre-set to the proper code of a specific conversation can receive it and reconstruct its fragments into normal speech flow.

...from anticipation to activation

AETRON ... designer-builder of rocket, missile and space facilities. AETRON... affording the ultimate integration of architecture, engineering, and instrumentation for the Space Age.

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Comparison of Major Computer Systems

KEY:

AD—on-line analog to digital converters
ADL—acoustical delay line
Ag—Analog
Al—alphabetical
An—alphanumeric
BCD—binary coded decimals
Bin—binary
C—commercial
CL—Communications line input and output
Cr—card reader
CRAM—card random access memory
CRT—cathode ray tube
DA—on-line digital to analog converters
DDA—digital differential analyzer
Dec—decimal
DL—delay line
DP—data processing
DR—data reduction
E—engineering
ET—electron tube
F—flexowriter
FG—function generator
GP—general purpose
GS—general scientific
HiSp—high speed printer
K—keyboard
MC—magnetic core
MchR—magnetic character reader
MD—magnetic drum
MDL—magnostrictive delay line
MF—hours meantime between failure
ML—magnetic ledger
MS—magnetic slug store
MT—magnetic tape
MW—magnetic wire
NT—nixie tube
O—operating
P—produced
Pat—paper tape
PC—punched cards
PBA—parallel binary asynchronous
Pcon—process control
Pots—Potentiometers
Pr—printer
PT—punched tape
RT—real time
S—scientific
Sca—raw data scanner
SD—sonic delay line
SP—special purpose
ST—avg. service time per mo.
TF—thin film
Tr—transistor
TT28—Teletype Model 28
Ty—electric typewriter
VT—vacuum tubes

Model	Manufacturer	Appli-cations	Numerical System	Input	Memory	Output	Power reqmnt.[2]	Sq. ft. Area rqmnt.	Cost in $1000s[3]	Rental per mo.	Reli-ability	Production record[7] P	Production record[7] O
Punched Card Calculators and Computer Systems													
604	International Business Machines	C-S	BCD	Cr-PC	ET-R	Cr-PC	7.59KVA	19.4	26	550	10ST	2993	—
607	International Business Machines	C-S	BCD	Cr-PC	ET-R	Cr-PC	13.5	36.5	37.5	800	—	267	—
609	International Business Machines	C-S	BCD	PC	MC	PC	1KW	12.1	55.5	1175	—	—	—
UNIVAC 60	Remington Rand	C-S	BCD	PC-Pat	VT	PC	10	43	75	740-1015	—	—	—
UNIVAC 120	Remington Rand	C-S	BCD	PC-Pat	VT	PC	10	43	97.5	1075-1350	—	—	—
Large Size Computer Systems													
G-20	Bendix Corp.	GP-S-DP-DR	Bin. floating point	PC-PT-MT-An-Ty	MC	PC-PT-MT-HiSp-An-Ty	3.5KVA	154	390	8750	—	—	—
5000	Burroughs Corp.	GP	BCD	MT-PC	MC-MD-MT	PCPT-HiSp	—	—	fm509	Avg.18,000	—	—	—
1604	Control Data Corp.	C-E-GP-GS-S-DR	Bin.	PC-MT-PT-Pat	MC-MT	MT-PC-PT-Pat	5KVA	400	900	25,000	.99	6	6
ATLAS	Ferranti Electric, Inc.	E-S	Bin.	PC-PT-MT	MT-MD-MC-MS	PT-MT-PC-Pr	80 KVA	2000	—	—	—	—	—
GE-150	General Electric Co.	DP	BCD	MchR-MT-Pat-F-G	MC-MT	R-MT	22KW	2000	800	24,000	.98	—	—
704	International Business Machines	E-C-S	Bin.	PC-MT	MC-MD-MT	MT-PC-Pr-CRT	96.4KVA	1350	1109	24,450	.98	—	—
705	International Business Machines	C	Al-BCD-Bin.	PC-MT	MC-MD-MT	MT-PC-Pr	97	2500	1500	26,000	.95	—	—
709	International Business Machines	E-C-S	Bin.	PC-MT	MC-MD-MT	MT-PC-Pr-CRT	130	2000	2484	34,700	.95	—	—
7070 (card, tape, RAMAC, RAMAC tape)-Tr	International Business Machines	E-C-S	Dec.	PC-MT	MC-MT-Disc-RAMAC	PC-MT-Pr	34KVA	950	547	12,000	—	—	—
7072	International Business Machines	E-C-S	Dec.	PC-MT	MC-MT	MT	32KVA	800	860.55	fm15,800	—	—	—
7074	International Business Machines	E-C-S	Dec.	PC-MT	MC-MT-Disc	PC-MT-Pr	38KVA	900	1284.35	fm17,000	—	—	—
7080	International Business Machines	C	BCD	PC-MT-K	MC-MD-MT	PC-MT-Pr	30KW	1000	2233	49,000	—	—	—

Model	Manufacturer	Applications	Numerical System	Input	Memory	Output	Power reqmnt.1/	Sq. ft. Area rqmnt.	Cost in $1000 2/	Rental per mo.	Reliability	Production record 3/ P	Production record 3/ I	Production record 3/ O
7090-Tr	International Business Machines	E-C-S	Bin.	PC-MT	MC-MT	PC-MT-Pr	40	1100	2590	58,300	—	8		—
L-3000	Librascope Div., General Precision, Inc.	GP-C-DR-DP	An	PT-MT-TT 28-Ty-K-AD	MC-MD-MT	PT-MT-TT28 Disc	30KW	200	750	—	.99+	—		—
DATAmatic 1000	Minneapolis-Honeywell Electronic Data Processing Div.	C-S	BCD-coded An	PC-K-PT-MT	MC-MT	PC-Pat-Pr-MT	110	550	985	21,500	.95	—		—
Honeywell 800	Minneapolis-Honeywell Electronic Data Processing Div.	E-C-S	BCD-coded An-Bin.	MT-CR-Pat-K-MchR	MC-MT	Ty-HiSp-Pr-PC-Pat-MT	60KVA	850	550	fm11,000	—	—		—
NCR-304	National Cash Register Co.	GP-S-E	Bin.-BCD-An	PC-MT-PT-K-MchR	MC-MT	MT-PT-PC-K-HiSp	20KVA	1500	800	12,500	.96	6		6
210-Tr	Philco Corporation, Computer Div.	GP-DP-DR-C-S-E	PBA	PC-MT-PT-F-RT	MC-MD-Disc	PC-MT-PT-F-HiSp-RT	24KVA	800	1250	27,500	.99	—		—
211-Tr	Philco Corporation, Computer Div.			SAME AS 210-Tr					1450	32,500	—	—		—
212-Tr	Philco Corporation, Computer Div.								2175	48,000	—	—		—
501	Radio Corporation of America	E-C-S	BCD-Al-Bin.	PC-Pat-MT	MC-MT	Pat-MT-PC-Pr	22KVA	1000	616	12,400	.95+	24		16
601	Radio Corporation of America	E-C-S	BCD-Al-Bin.	PC-Pat-K-MT	MC-MT	Pat-MT-PC-Pr	29KVA	1300	1115	24,505	—	—		—
LARC-Tr	Remington Rand	GP	BCD	MT-K-MD	MC-MD	MT-HiSp	350KVA	3000	7000	135,000	—	1		1
UNIVAC I	Remington Rand	GP	BCD	MT-K-Pat-PC	DL	MT-PC-Pat-HiSp	124.5	2500	1279	23,000	.93	—		48
UNIVAC II	Remington Rand	GP	BCD	MT-K-Pat-PC	MC	MT-PC-Pat-HiSp	143.9	2500	1350	28,000	.93	32		—
1103A	Remington Rand	S-DR	Bin.	Pat-PC-MT-AD	MC-MD	Pat-MT-PC-DA-HiSp	100	1560	1500	35,000	—	—		—
1107	Remington Rand	RT-C-S	Bin.	PT-PC-MT-Ty-AD	MC-MD-TF	MT-HiSp-Pat-PC-Ty	93KVA	267	1800-2700	50,000	—	—		—
490	Remington Rand	RT-C-S	Bin.	PC-PT-Ty-MT-AD-CL	MC-MD	PC-PT-Pr-Ty-MT-CL	61KVA	196	810 (open)	25,000	—	—		—
M-460	Remington Rand	S-DR	Bin.	Pat-MT-PC-AD	MC-MD	Pat-MT-PC-DA	1.2	27	750	—	—	—		—
1105	Remington Rand	GP	Bin.	MT-PC-Pat-AD	MC-MD	MT-Pat-PC-DA-HiSp	170	3000	2172	43,000	—	—		—
UNIVAC III	Remington Rand	GP	BCD-Bin.	MT-K-PC	MC	MT-PC-Pr-HiSp	52KVA	1440	1000	15-30,000	—	—		—
1206	Remington Rand	GP-DP-Military	Bin.	Pat-MT-PC-MD-F-K-AD-CL	MC	Pat-MT-PC-AD-F HiSp-DA-CL	2.4KVA	8.2	450-560	—	200MF	12		12
MOBIDIC	Sylvanic Electric Products, Inc.	GP-E-S-DP	Bin.	F-K-PT-PC-Ty-MT	MC-MT-M Disc File	Pat-R-MT-F5/-HiSp	—	800	—	—	.99+	1		1
9400	Sylvanic Electric Products, Inc.	E-GP-S	Bin.	PC-MT-PT-M Disc file-F-K-RT-Cr	MC-MD-MT	PC-MT-HiSp-Pat-F-PT	208V	950+	—	—	—	1		1
RW-400	Thompson Ramo Wooldridge, Inc.	C-E-S-DR-DP	Bin.	CR-E-MT-PT-K-DC	MT-MC-MD	F-MT-HiSp-Pr-PT-Ty	30	200	—	—	.99+	4		3

*Medium Size Computer Systems*4/

ALWAC III E	Alwac Computer Div., El-Tronics	GP	Bin.	PC-PT-MT-F	MD	PC-PT-MT-F	8KW	28	77	1770	.97	3		—
G-15	Bendix Corporation	GP-S-DP-DR	Bin.	PC-PT-MT-K	MD	PC-PT-MT-Ty Plotter	3.8KVA	6.5	49.5	1485	.98	300		300
220	Burroughs Corporation	GP	BCD	PC-PT-K-MT	MC-MT	Ty-PT-MT-PC-HiSp	45KVA	1600	fm320	12,250	.98	—		42
205	Burroughs Corporation	GP	BCD	PC-PT-K-MT	MD-MT	Ty-PT-MT-PC	38KVA	1600	fm79	5760	.97	—		112
251	Burroughs Corporation	C	Bin.	PC-Mag. En-Cod. Docum	MC	Visb. Records-HiSp	120/240V (Sgl.ph 60cyc)	525	217	4000	—	—		—
MARK I	Ferranti Electric, Inc.	S	Bin.	PT	MD-CRT	Pr-PT	26KW	600	400	—	.97	—		—
MERCURY	Ferranti Electric, Inc.	S	Bin.	PT-MT	MC-MD	PT-Pr-MT	40KVA	36	400	—	—	—		—
PEGASUS	Ferranti Electric, Inc.	S	Bin.	PT-MT	MD-ADL	PT-Pr-MT	12KW	60	200	—	.98	—		—
PEGASUS 2	Ferranti Electric, Inc.	E-C-S	Bin.	PT-PC-MT	MD-ADL	PT-PC-MT	50KVA	1000	—	—	.95	—		—
ORION	Ferranti Electric, Inc.	E-C-S	BCD	PC-PT-MT	MT-MD-MC	PT-PC-MT-Pr	1.5KV/	1200	—	—	—	—		—
GE-210	General Electric Company	DP	BCD	MchR-MT-Pat-F-Cr	MC-MD-MT	Pr-MT	12KW	1200	400	12,000	.98	8		8
GE-225	General Electric Company	GP	Bin-BCD	PC-PT-MT-MchR	MC-MD-MT	PC-MT-HiSp-PT	10KVA	800	250	5000	.98	—		—
650 (card)	International Business Machines	E-C-S	Dec.	PC-PT	MD	PC-Pr	17.7KVA	250	182	3750	.95	—		—
650 (tape)	International Business Machines	E-C-S	Dec.	PC-MT-PT	MD-MC-MT	PC-MT-Pr	50	1000-1200	356	7500	.90	—		—
RAMAC 650	International Business Machines	DP	Dec.	PC-PT	MD-MC-Disc	PC-Pr	50	1000-1200	374	7300	.90	—		—
RAMAC 650 (tape)	International Business Machines	E-C-S	Dec.	PC-PT-MT	MC-MT-MD-RAMAC (Disc)	PC-MT-Pr	60	1800	432	8750	.90	—		—
RAMAC 305	International Business Machines	DP	BCD-Al	PC-PT	MC-MD-Disc	PC-Pr-Ty	16	400	190	3250	.90	—		—
1401-Tr	International Business Machines	C	BCD	PC-MT-Pat-K	MC-MT-RAMAC (Disc)	PC-MT-Pr-Ty	3.2-17KVA	fm 336	125.6	2475	—	2800		—
1410	International Business Machines	C	BCD	PC-MT-Pat-K	MC-MT-RAMAC (Disc)	PC-MT-Pr-Ty	30KVA	1000	244.55	5365	—	—		—
MK-130	Librascope Div., General Precision, Inc.	GP-RT	Bin.	PT-DA-F	MC-MDL	PT-An err. sig.-F	3KVA	8.5	400	—	.99+	1		1
LIBRATROL 500	Librascope Div., General Precision, Inc.	C-E-S-GP	Bin.	Ag-Ty-K-Pat-Switch	MD	Ag Ty-PT Relays-MT	2KW	16	85	—	.98	400		380
LIBRATROL 1000	Librascope Div., General Precision, Inc.	C-E-S-GP	Bin.	Ag-Ty-K-Pat-Switch	MD	Ag Ty-PT Relays	1KW	16	120	—	—	—		—
Honeywell 400	Minneapolis-Honeywell	C	BCD-coded-An	Pat-PT-PC-	MC-MT	HiSp-Pat-PC-	25-30KVA	600-825	390	8660	—	—		—

LIBRATROL 1000	Librascope Div., General Precision, Inc.	C-E-S-GP	Bin.	Ag-Ty-K-Pat-Switch	MD	Ag Ty-PT Relays	1KW	16	120	—	—	—	—
Honeywell 400	Minneapolis-Honeywell Electronic Data Processing Div.	C	BCD-coded-An	Pat-PT-PC-Cr-K	MC-MT	HiSp-Pat-PC-MT-Ty	25-30KVA	600-825	390	8660	—	—	—
MONROBOT VI	Monroe Calculating Machine Co.	S	BCD	K-Pat	MD	Pr-Pat	17KW	40	95	—	.98	—	—
NCR-315	National Cash Register Company	GP-S-E	BCD-An	PC-MT-PT-K-MchR-CRAM	MC-MT-CRAM	MT-PT-PC-K-HiSp-CRAM	13.5KVA	500	308.5	6275	—	1	—
PB-250	Packard Bell Computer Corporation	GP-S-E-DR-DP	Bin.	PT-MT-PC-F	MDL-MC	PT-MT-PC-F-HiSp	100	3.2	39	—	1.00	9	9
TRICE	Packard Bell Computer Corporation	S	Bin.	PT-K-AD	DL	PT-DA-XY Plot-Readout Register	480	12	100	—	.97	5	4
2400-Tr	Philco Corporation, Computer Div.	DP-DR-C-S-E	Bin.	PC-PT-MT-RT	MC	PC-PT-MT-RT-HiSp	—	120	350	7800	—	—	—
Basicpac-Tr	Philco Corporation, Computer Div.	GP-DP-DR-C-S-E	Bin.	PC-PT-MT-K-RT	MC	PT-MT-K-RT	5KVA	80	500	—	.99	—	—
301	Radio Corporation of America	E-C-S	BCD-Al-Bin	PC-Pat-K-MT-Mchr	MT-MC-disc.	Pat-PC-MT-Pr	12KVA	400	164	3,315	.95+	—	—
UFC-0	Remington Rand	C	BCD	MT-Ty-PC-Pat-Spec.	MD	MT-PC-Pat-Ty-HiSp-Spec.	30	1000	300	7,000	—	—	—
UFC-I	Remington Rand	C	BCD	MT-Ty-PC-Pat-Spec.	MC-MD	MT-PC-Pat-Ty-HiSp-Spec.	75	1400	600	15,000	—	164	110
UFC-II	Remington Rand	C	BCD	MT-Ty-PC-Pat-Spec.	MC	MT-PC-Pat-Ty-HiSp-Spec.	75	1400	600	15,000	—	—	—
USS-90	Remington Rand	GP	BCD	PC-MT	MD	PC-MT-HiSp	14.4	800	168-624	3,500-13,000	—	—	—
USS-80	Remington Rand	GP	BCD	PC-MT	MD	PC-PR-MT-HiSp	14.4	800	168-624	3,500-13,000	—	—	—
RPC-4000	Royal McBee Corporation	GP	Bin.	PT-Ty-K	MD	PT-Ty-HiSp	.72KVA	100	87.5	1,750	—	10	2
RPC-9000	Royal McBee Corporation	GP	BCD	PT-PC-Ty-MT	MT	PT-PC-Ty-HiSp-MT	.2KVA	150	120	2,450	—	10	4
M-64	Sylvania Electric Products	GP-E-S	Bin.	Pat-MT	MC	Pat-MT-RT-HiSp	3KVA	20	—	—	—	—	—
AN/UYK-1	Thompson Ramo Wooldridge, Inc.	C-DP-DR-E-GP-GS-SP	Bin.	AD-TT28-Pat-PT-Pr-MT	MC	TT28-DA-Pat-PT	1KW	2.3	75	—	.99+	—	—

Small Size Computer Systems

FADAC[e]	Autonetics Div., North American Aviation	GP-GS-E	Bin.	Pat-MT-K-FADAC	disc.	PT-Ty-MT-NT-FADAC	Tr.	5.3	—	—	—	—	—
Recomp II	Autonetics Div., North American Aviation	GP-S-E	Bin.	Pat-K-Ty-MT	disc.	Ty-PT-NT-MT	Tr.	14.1	95	2,495	—	—	—
Recomp III	Autonetics Div., North American Aviation	GP-S-E	Bin.	Pat-Ty	disc.	PT-Ty	Tr.	desk	65	1,495	—	—	—
VERDAN	Autonetics Div., North American Aviation	GP-GS-S-E	Bin.	K-PT-MT-pulse shaft	disc.	PT-MT-display-Ty-voltage, shaft-Bin.	Tr.	1.4 cu. ft.	—	—	—	180	180
E101	Burroughs Corporation	C-S	pulse coded dec.	K-DC-PT	PT-MD	Pr-PT-PC	3KW	desk	25.5	875	.96	—	127
160	Control Data Corporation	C-E-GP-GS-E-DR	Bin.	MT-PC-PT-Pat	MC-MT	MT-PC-PT-Pat-Pr	1200W	desk	60	1,500	.99	7	4
160-A	Control Data Corporation	C-E-GP-GS-DP-DR	Bin.	MT-PC-PT-Pr	MC-MT	MT-PC-PT-Pr	1400W	desk	90	2,250	—	—	—
SIRIUS	Ferranti	E-C-S	BCD	PT-PC	ADL	PT-PC	8KW	100	—	—	—	—	—
READIX II	Idaho Maryland Industries Inc.	GS-GP-DP-E-DR-GS	BCD	PC-Pat-Cr-MT-PT-K-Ty-An-MD	MC-MD	PC-Pat-Cr-MT-PT-K-Ty-An-MD	6KVA	144	65	2,500	.94	6	6
1620-Tr	International Business Machines	S-E	BCD	Pat-Ty-PC	MC	Pat-Ty-PC	2KW	21.8	74.5	1,600	—	—	—
MONROBOT XI	Monroe Calculating Machine Company	GP	Bin.	TT28-PC-Ty-Pat-K	MD	Ty-PC-Pat-TT28	9KW-Tr.	16	24.5	700	.98	7	6
Distributape (Monrobot X)	Monroe Calculating Machine Company	SP	Bin.	Pat	MD	Pat	2KW	20	35	—	.90	3	2
MONROBOT IX	Monroe Calculating Machine Company	C	Bin.	Ty	MD	Ty-PC	.6KW	desk	9.6	340	.95	70	70
NCR-390	National Cash Register Company	GP	BCD	PT-PC-K-ML	MC-ML	PT-PC-Pr-ML	3KVA	40	71.5	1,785	.97	6	6
C-3000 Tr	Philco Corporation, Computer Div.	S-E-PCON	Ser.-Bin.	PT-F-K-Shift Regs.	MD	PT-F	.5KVA	4.5	On Request	—	563MF	2	1
LGP-30	Royal McBee Corporation	GP	Bin.	K-PT-PC	MD	F-PC-PT-Ty	115	50	43.5	1,100	.95	462	450
RW-300	Thompson Ramo Wooldridge, Inc.	C-E-DP-DR-GD	Bin.	F-MT-PT-K	MD-MT	F-MT-PR-PT-Ty-CRT	.6	desk	98	—	.99+	—	18

Special Purpose, Experimental, etc.[4]

AD-1	Applied Dynamics, Inc.	GS-E	Ag	FG	—	CRT-XY-Plot Strip	.6KW	desk	2-20	—	.98	—	—
AD-1-16	Applied Dynamics, Inc.	GS-E-DR-GP	Ag	FG-Pots	Pots-Integrators	Strip chart recorder, XY Plotter-CRT	.2KW	4	4	200	.98	—	—
AD-1-32	Applied Dynamics, Inc.	GS-E-DR-GP	Ag	FG-Pots	Pots-Integrators	Strip chart recorder, XY Plotter-CRT	.4KW	6	8	400	.98	—	—

Model	Manufacturer	Applications	Numerical System	Input	Memory	Output	Power reqmnt.[1]	Sq. ft. Area reqmnt.	Cost in $1000's	Rental per mo.	Reliability	Production record[7] P	Production record[7] O
AD-1-32PB	Applied Dynamics, Inc.	GS-E-DR-GP	Ag	FG-Pots	Pots-Integrators	Strip chart recorder, XY Plotter-CRT	.4KW	6	10	500	.98	—	—
AD-1-64PB	Applied Dynamics, Inc.	GS-E-DR-GP	Ag	FG-Pots-F	Pots-Integrators	Strip chart recorder, XY Plotter-CRT-F-HiSp	.8KW	10	20	1,000	.98	—	—
AD-1-128PB	Applied Dynamics, Inc.	DR-GP	Ag	K-PT	Pots-Integrators	PT-HiSp	1.5KW	15	50	2,000	.98	—	—
1132U	Beckman Instruments, Berkeley Div.	R-D-E-GP-GS-S-RT-SP	Ag	F-K-Pat-PT-Prob. Board	—	F-K-Pat-PT-CRT-DVM-PR-XY Plot-strip chart	6KW	12	20	—	—	—	—
1132	Beckman Instruments, Berkeley Div.	R-D-E-GP-GS-S-RT-SP	Ag	F-K-Pat-PT-Prob. Board	—	F-K-Pat-PT-CRT-DVM-PR-XY Plot-strip chart	10KW	20	30	—	—	—	—
1133	Beckman Instruments, Berkeley Div.	R-D-E-GP-GS-S-RT-SP	Ag	F-T-Pat-PT-Prob. Board	—	F-K-Pat-PT-CRT-DVM-PR-XY Plot-strip chart	20KW	20+	60	—	—	—	—
Argus GS-312 RD-900	Ferranti Electric, Inc. General Electric Company Laboratory for Electronics, Inc.	Pcon E-S Aux. Stor. display	Bin. Bin. Bin.	— F-Pat-Ag-Scn MT-Pat-K-Comput. Output	— MD MD	— F-PT CRT-Projector	— 4KW 12.5KW	— 18 600	— 80 300	— — 6,000	— — 100MF	— 4 —	— 4 —
ATC (air traffic data control processor)	Librascope Div., General Precision, Inc.	GP-mil surveill.	An	Pat-TT28-Ty	MD	Ty-F display	90 (for entire 4 comp. sys.)	160 (entire system)	—	—	—	2	—
ASN-24	Librascope Div., General Precision, Inc.	Aircraft-Missile	Bin.	On Request	MD	On Request	120W	.9	—	—	—	4	3
CG-24	Mass. Inst. of Technology	GP-RT-radar data	Bin.	Radar data-F-MT-photo reader	MC-Toggle switches	F-CRT-MT-antenna positioning serv.	5KW	100	—	—	—	—	—
ATHENA TIC M-90	Remington Rand Remington Rand Sylvania Electric Products, Inc.	DR DR-GP SP-RT	Bin. Bin. Bin.	Pat-F F-MT PC-MT-K-CR-AD-RT	MC-MD MC-MW MC-MT	Pat-MT-F F-MT MT-Pr-PC-Pat-F-RT	800W 2.5KVA 10KW	250 35 43	— — —	— — —	.998 600MF —	— — —	— — —
UDOFFT MANIAC II	Sylvania Electric Products, Inc. University of California	SP-RT Physical Research	Bin. Bin.	PC-K-CR-AD PT-MT-K	MC MC-MT-CRT	Pr-RT-MT-Ty-CRT	28KVA 30KW	1200 150	— 350	— —	— —	— 1	— —

NOTES: Because of confusion surrounding access times and speeds, which are not standardized, they are omitted.
1/Power requirement and area requirements are for the basic computer only—do not include air conditioning and the like.
2/Cost and rental figures are for basic computer system only and are approximate.
3/Includes refrigeration.
4/Computers listed here are only a representative sampling of the several score machines which have been built, primarily in quantities of one or two, mainly by universities or the services themselves to serve a special purpose.
5/Up to 63 input-output devices including disc memory and teletype terminals.
6/FADAC outputs to and accepts input from another FADAC directly.
7/Based on Ballistic Research Laboratories Report No. 1115 of March 1961.

New Computer Language Available Next Month

The manuscript of a revised report on a Common Business Oriented Language for programming digital computers has gone to the Government Printing Office for publication, according to Charles J. Hitch, Assistant Secretary of Defense (Comptroller).

The report, COBOL-61, was made to the Conference on Data Systems Languages by a Special Task Group representing 11 computer manufacturers, Department of Defense and other major users of computers.

COBOL-61 updates the COBOL report issued April 1960, which set out the initial specifications for the Common Business Oriented Language. Copies of COBOL-61 will be available next month at the Superintendent of Documents, Government Printing Office, Washington 25, D.C.

mathematical problem:
$d = a\ (b + c)$

ALGOL statement:
D : = A × (B + C);

data processing problem:
FICA DEDUCTION = FICA RATE (GROSS PAY + RAISE)

COBOL statement:
COMPUTE FICA-DED EQUALS FICA-RATE TIMES (GROSS-PAY PLUS RAISE)

Simple examples of the two universal automatic computer programming languages, ALGOL (Algorithmic Language) and COBOL (Common Business Oriented Language), show how closely they resemble their pure derivatives, algebra and English.

Some large companies (U.S. Steel for instance) have gone so far as to try to set up a system in Spanish for overseas operations.

Through the use of the COBOL method of programming, it is anticipated that in addition to inter-changing programs among locations which use different makes and models of computers, it will be possible also to reduce the time and cost that has been involved in writing computer programs and revising such programs.

DOD expects to save as much as $20-million a year in computer program costs, as well as give Defense top management a language they can understand so they will know if the computer is doing what they want it to do, or more precisely, is being given the right instructions.

Time required for training programmers is shortened and the training simplified with the COBOL technique.

...key to life

Water means power . . . water means raw materials . . . water means the life of the maritime nations. Still—man is ignorant of the mysteries of the oceans . . . he is only beginning to search the depths.

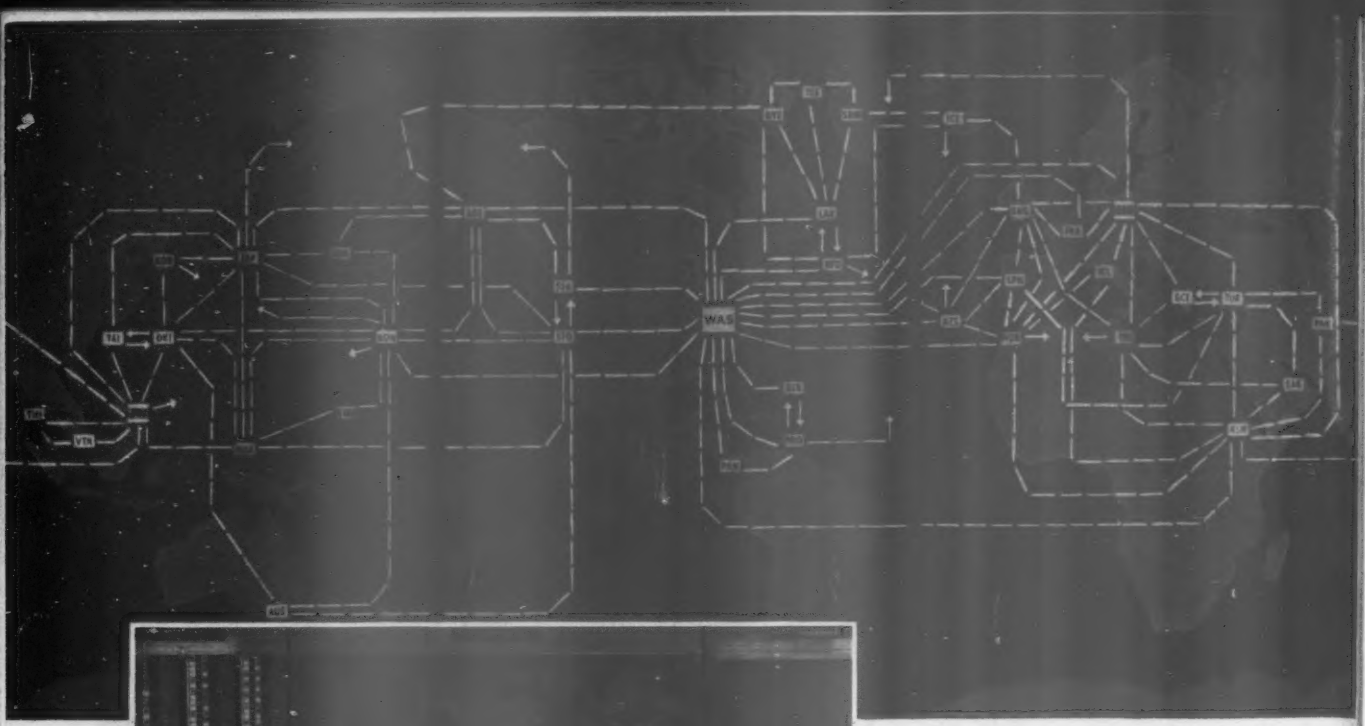
General Motors Defense Systems Division is vitally interested in all ocean phenomena. For example, new nuclear submarines and their cargoes of ballistic missiles constitute one of America's most effective deterrents against attack. Water—and the *control* of water—is vital to national defense.

Scientists and engineers in the laboratories of the Defense Systems Division are also hard at work in land, aero-space, astrophysics, biological sciences, oceanography, nucleonics, and basic research projects.

DSD is dedicated to serving the Defense Department and other government agencies, in cooperation with many different branches of industry and scientific groups, in fields of fundamental research and engineering through the coordination of knowledge, abilities, ideas and hard work.

General Motors is proud to contribute, through the growing Defense Systems Division, to the strength of America and human progress. Top-level scientists and engineers in all of these specialized fields will find rare opportunities and challenging assignments in this fast-growing organization.

DEFENSE SYSTEMS DIVISION, GENERAL MOTORS CORPORATION, WARREN, MICHIGAN AND SANTA BARBARA, CALIFORNIA



The Defense National Communications Control Center by Philco

FINGER-TIP CONTROL FOR **GLOBAL COMMUNICATIONS**

Keeping U. S. Armed Forces communications traffic flowing rapidly and efficiently is an enormous task. The Defense National Communications Control Center was designed, fabricated and installed by Philco for the Defense Communications Agency to provide the means to monitor and control this gigantic traffic load.

The Control Center is constantly supplied with the current world-wide status information by stations operated by the Army, Navy and Air Force. This information is processed by the Center, where the status of the entire world-wide system is displayed in order that control can be exercised. When a breakdown or overload occurs anywhere in the system, communications are restored and vital information is quickly re-routed through alternate channels.

Another major contribution by Philco for National Defense.

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Communications and Weapons Division • Communications Systems Division
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Procurement Trends

Computer Buy Cheaper Than Rent?

Bureau of the Budget is currently in the midst of cranking out a directive to all Government users of computers. Directive will urge that agencies (1) not overlook comparing the values of Government's buying computers outright rather than the currently more common practice of renting; (2) insisting that from now on agencies back up decision on particular piece of hardware with an indication that they did do a competitive evaluation, and justify the choice of one piece of hardware over the other.

Reason for first item: Budget Bureau thinks Government can get a better deal through buying hardware rather than renting it. Only drawback: IBM, for instance, is not likely to allow much on trade-in on a "used Univac" and vice versa.

Defense to Follow Lockheed Pattern

Extension of the non-discrimination provisions of the Lockheed contract to all major Defense contracts is a foregone conclusion at the Pentagon. Reason: not only is the Lockheed theory indorsed as a progress milestone by the White House Committee on Equal Employment Opportunity, but it has the President's personal blessing. Note: the Lockheed stipulation will also be applicable to the employment practices of subcontractors, and if necessary this will be accomplished by appropriate amendments to the Armed Forces Procurement Regulations.

Services Seek Score on Labor

Despite opposition from industry and organized labor, the Labor Department is expected to establish without hearings new criteria for the application of the Davis-Bacon Act to construction activities involved in Defense space experiments. The question was brought into focus by recent labor difficulties at Cape Canaveral over the installation of electronic equipment on missile sites. One solution proposed by the Air Force is amendment of the Act to let the electronics industry rather than a construction firm do the construction work necessary on site.

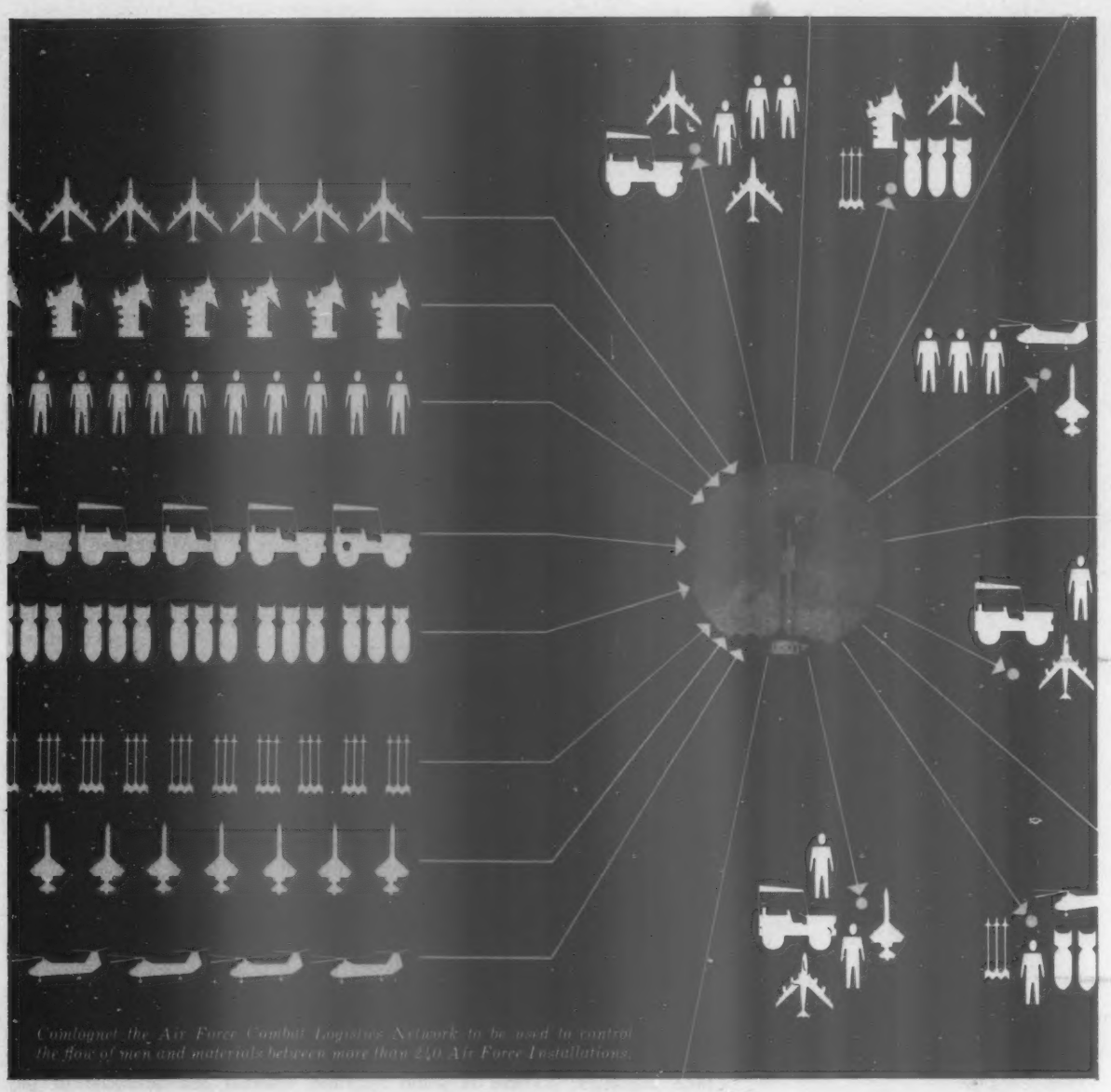
Up to now, the Air Force interpretation of the Act has been that it is applicable if the construction work involved in the missile operation amounts to $2,000 or more. The Army and Navy, on the other hand, felt the Act should not apply if the construction was incidental to the missile work. Air Force comment: "There is some question whether it's desirable to pay through the nose for construction. We cannot afford to indulge in uneconomical practices just to buy labor peace."

Bonus Exemption Plans Shelved

Proposals to exempt bonus payments on incentive contracts from the renegotiation process have been shelved for the time being by the Pentagon. Reason: in view of criticism of incentive contracts by the General Accounting Office and Congress, any relaxation of the renegotiation process at this time would be vulnerable.

Incentive type contracts have not fallen into disfavor and Defense still believes in the theory that the contractor who beats the target is entitled to share in the benefits. At the same time, Defense feels that the manufacturer who fails to beat the target should be willing to shoulder his share of the losses.

Said one Pentagon contracting expert: "I predict that the bonus will not be sacrosanct. We will continue in the same fashion as now. There is some point to the contention that when a bonus is earned, industry is entitled to it. But—if you are particularly virtuous on one contract and sin on the others, you still must return some of the money."



Comlognet, the Air Force Combat Logistics Network to be used to control the flow of men and materials between more than 240 Air Force Installations.

COMLOGNET:
world's most advanced data communications system designed for the Air Force by Western Union.

This instantaneous communications and data network has the capability of handling every known form of electronic communications swiftly, accurately, and automatically. Upon completion in 1962, Comlognet will have a daily capacity of seven million punched cards in its five U.S. centers, making it the world's largest data processing system. Future expansion, including the handling of data from overseas installations, will be readily accommodated.

Modernization of Comlognet is another first for the U.S. Air Force and Western Union. Acting as prime contractor, Western Union designed and engineered this electronic network in participation with other companies.

WESTERN UNION...*finds better ways to speed it electronically*

APD Expands Schooling

Computer at Army school enables students to multiply decision-making experience by eliminating paper work; realism intensified by scenario programmed to present problems which could develop in actual operations.

AUTOMATIC DATA PROCESSING is telescoping time at the Army's Logistics School and gives the students 30 times as much experience in solving logistics problems as they could get prior to the installation of ADPS as an instruction tool.

Identified as Logistics Simulation, Wholesale, Computer Assisted (LOG-SIM-WC), the simulation was designed and installed by the International Business Machine Corporation. It went into operation four months ago and its heart is an IBM RAMAC 305 computer.

The Logistics School is the principal activity of the U.S. Army Logistics Management Center (USALMC), Fort Lee, Virginia. Approximately 1,600 students attend its various courses each year. The simulation has been integrated into the three principal courses from which about 600 students are graduated annually. These are Army Supply Management (12 weeks), Requirements Management and Distribution Management (8 weeks).

The Students

The military members of the student body are field-grade officers—a good number of which are from NATO and other friendly nations—and the civilians hold Civil Service grades of GS-11 or above. All have had previous experience in the logistics field.

The school inaugurated manual simulation of logistics problems in 1958. Before the advent of the computer, however, it was never possible to approach the scope of the simulation the Army school now operates.

The big difference is in the increased capacity for actual decision making made possible by use of the computer. Colonel Carl R. Yost, director of the management center's Control Division, estimated that before the computer was in operation the students spent about 80 percent of their time on the paper work involved in their solutions to the school problems. With the computer carrying most of the paper work burden, he said, the students can now apply about 80 percent of their time to the formulation of their decisions.

When the students had to do their own paper work, they had their hands full grappling with about three selected items of supply in simulated movements and shipments between three supply depots and customers in the Continental United States. Now they can cope with up to 50 selected items in logistical movements among eight depots and customers in CONUS and two depots overseas.

The USALMC was organized in 1956 to fill a critical need for the advanced training of management personnel in the Army's wholesale supply system. Its mission was to develop the management skills of middle and top-level supply managers and provide uniform training in the Army-wide aspects of supply management. The introduction of the new computer-assisted simulation on March 1 last is regarded as a major contribution to the accomplishment of the mission.

No longer are the students required to complete laborious calculations in establishing the basis for a decision. The computer takes care of that job, presents the facts pertinent to the problem in rapid fire fashion, and the students are free to concentrate on their recommendations.

The theory behind the new method of instruction is not to increase the number of logisticians completing the course, but to broaden their field of experience by improving their ability to make sound decisions.

In each simulation, the students of the logistics courses are divided into groups of eight to ten. This stimulates the decision making process, provides the basis for studies in group dynamics, builds up a spirit of inter-group competition which boosts individual motivation, and insures a more or less continuous utilization of the computer facilities.

Each of the groups represents a supply management group at an Army National Inventory Control Point (NICP), and the leader of each is usually the senior military member.

ANNOUNCING . . . FROM OPERATIONS RESEARCH INCORPORATED

the establishment of:

THE INSTITUTE FOR MANAGEMENT DYNAMICS

The efficiency of management is a major determinant in corporate survival today. And because of the constant need for improved management techniques, ORI's Institute for Management Dynamics (IMD) was formed.

The Institute is dedicated to the design and development of advanced management information systems. A typical example is ORI's improvement of the PERT system in which ORI's leadership is nationally recognized.

Institute management science programs presently cover:

- **RESEARCH** into problems of managing complex programs encompassing research, development and production.
- **DESIGN AND IMPLEMENTATION** of systems including extension of PERT-like systems into areas of cost, manpower and reliability management.
- **TRAINING** for the development of in-house capability of military and civilian organizations which want to install PERT-type systems.

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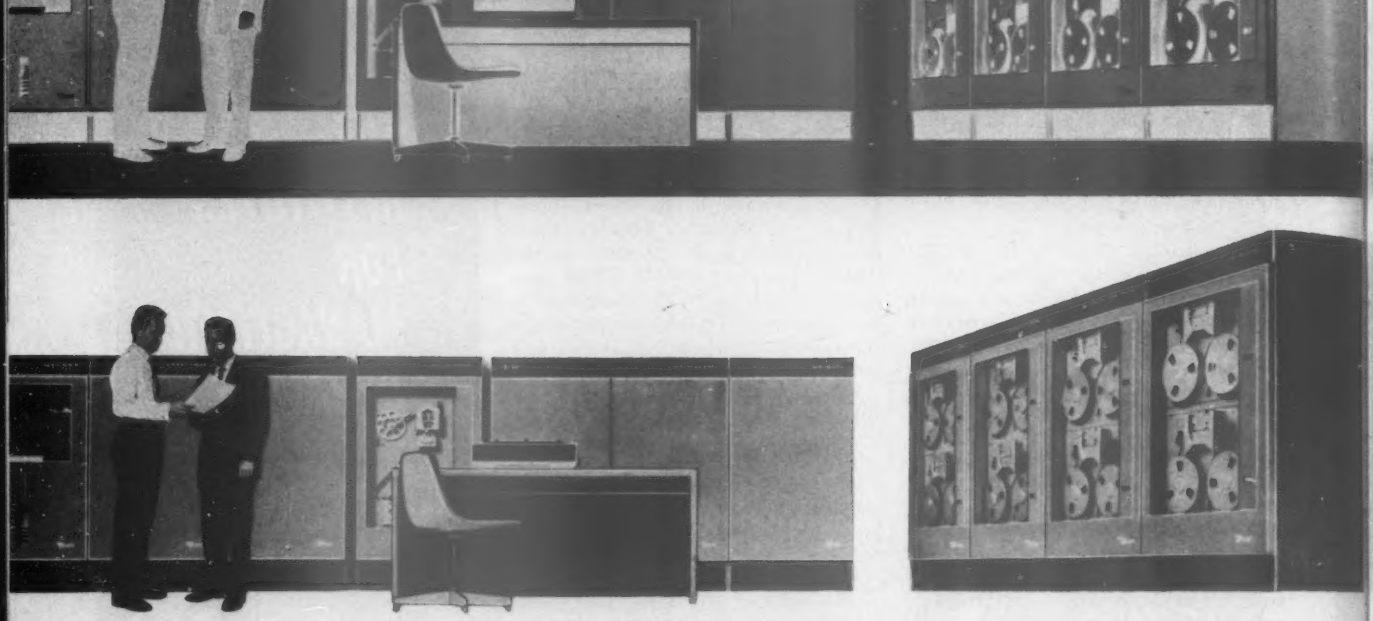

Bendix G-20

With the Bendix G-20 you are a two computer company. Incorporating both commercial and scientific data handling capabilities, the G-20 computing system permits all functions of your organization—engineering and administration, manufacturing and marketing—to meet their combined data processing needs in a single cost saving move. ▪ The G-20 contains a complete automatic programming "package"—including algebraic and business-language compilers which allow engineers and EDP personnel to write computer programs quickly and easily . . . in the natural language of the problem. The G-20's "packaged intelligence" masterminds the automatic scheduling of multiple problem processing—commercial and scientific intermixed—and maintains maximum system use and efficiency. ▪ And your G-20 configuration can always match exactly the changing requirements of your particular computing/data processing "mix". . . assuring maximum utilization of your specific system. ▪ Consult your own engineers and methods people. They'll recognize the multiple-purpose capabilities of the Bendix G-20 . . . and the budget wisdom of using one computer to handle the data processing demands of your entire organization. ▪ For application bulletin "A Solution to the Profit Squeeze," write:

Bendix Computer Division
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The decisions and activities of each group are simulations of those which actually occur at an operating NICP. The areas covered include: Budget Preparation, Requirements Determination, Procurement, Distribution, Repair and Disposal Direction.

The supply items to be handled by the group are culled from a list of 500 line items selected as a representative sample of the total line items in the U.S. Army Supply System. These range through principal items, major and minor secondary items, repair parts, high, medium and low dollar value items, fast and slow moving items, substitutes, and items being phased in and out of the system.

During any one simulation, the number and type of items handled are the same for each group. These totals vary, however, from one simulation to another. In a maximum system simulation, five major items and 45 minor secondary and repair part items can be used. The average class is subject to the problems involved with about 20 items, four of them major.

Each group operates independently of the others and progresses according to its own capabilities. If the problems scheduled for one instruction hour—equivalent to one month in real time—are solved to the group's satisfaction, the group may move to the next time frame without waiting for the other groups.

Other Material

In addition to the list of items to be handled, other material furnished to the group as the simulation gets under way at the beginning of each time frame describes the supply position and furnishes pertinent data on which the supply management decisions can be based.

These data include computer output documents such as supply control studies, stock status reports and historical demand records. Additional guidance on world political and economic conditions is made available in the form of world news summaries and simulated letters and directions from field commanders, chiefs of technical services, the Deputy Chief of Staff for Logistics and the Comptroller.

The group registers its management decisions by punching IBM cards with a special hand-held device. These cards are fed into the computer to record the team's choice of 51 actions that may be directed on any one item. Action examples are direct procurement of an item, direct repair, and shipment from one depot to another.

The 12-week course in Supply Management is designed to cover logistics situations which would be encountered over a four-year period. At the start of each LOGSIM game, each team is presented with a summary of the status of the 20-odd items that will have to be managed for the next four "years" and a synopsis of the world situation as it might affect the operations.

Within the memory of the 305 is already lodged a scenario comprised of a series of very realistic events and problems. These are unknown to the students and are programmed to crop up to affect, or be affected by, the supply decisions the students will be making as the simulation progresses.

There are no "school solutions" to these problems, no absolute "right" or "wrong" answers. Instead—and this is one of the distinguishing characteristics of LOGSIM-WC—the computer automatically merges and relates the problems and decisions in a dynamic way, as in real life at a supply depot.

Typical of the scenario events are changing budget restrictions, civilian disasters, labor difficulties, mobilization requirements, and international complications. These occasionally call for top-level advice. Accordingly, in a control room connected by intercom with the groups operating independently in adjoining areas a faculty member stands by who is competent to render command decisions when a major crisis develops in the formulation of a group decision.

This control officer wears many hats. He can be a manufacturer's representative with a new calculation on lead time. He speaks as a comptroller advising that PEMA funds cannot be transferred to the M&O account without specific authorization from Congress—and he can determine whether or not Congress is in session.

The control officer also can be a furniture manufacturer, estimating when—if ever—his burned-out factory will be capable of resuming activities. He can be a harassed employer reporting on the progress of negotiations leading to a possible strike settlement. He can be a top policy man in the Pentagon relaying advice on the international situation.

Pacing the decisions and actions of the individual groups is a scoring system based on a complex arrangement of credits and penalties for each step and implication involved when weighed against all appropriate factors.

The school does not place emphasis on the scores since systems as complex as the wholesale supply system do not lend themselves to adequate evaluation by the numbers.

As one of the students put it: "You can really goof on one of these problems without costing the Government anything. But it pays off in the end, because you won't make the same mistake again in real life." ■

ANNOUNCING . . . FROM OPERATIONS RESEARCH INCORPORATED

MANAGEMENT COSTING SEMINARS

The relationships between planning-scheduling activities and fiscal-resources requirements are a daily challenge to management.

Operations Research Incorporated announces two-day Management Costing Seminars to enhance government and industry understanding of the current state-of-the-art in management costing techniques and the resulting effect on resources tradeoffs.

The seminars are conducted by experienced ORI instructors and require six months working knowledge in the design and operation of management information planning and scheduling.

Note the MANAGEMENT COSTING seminar schedule on your calendar:

- Eastern Center: Sept. 18-19
- Chicago: Aug. 14-15 (Write Eastern Center)
- Western Center: Sept. 21-22

Write or call the ORI center of your choice:

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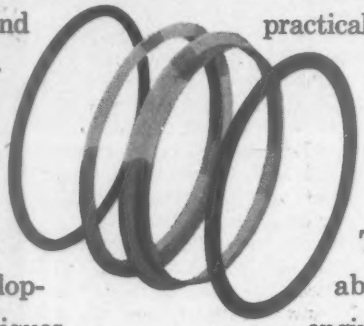
Problem: Sealing of heavy-vehicle track components. *Needed:* A seal to keep lubricant in, dirt, sand, grit and water out. *Produced:* A metal-to-metal, floating ring seal by Caterpillar. The result of basic research in metals, rubber compounds, and lubricants—plus development of new tooling techniques.



This advance in sealing design permits use of more effective lubricants and eliminates expensive day-to-day maintenance.

Such developments as this typify Caterpillar capabilities in producing sound, practical solutions for mobility needs.

As a leading producer of heavy equipment, Caterpillar has outstanding resources in research, engineering and manufacturing. This experience and talent are available to you to meet your vehicle, engine, or component requirements.

For details of capability, write for Bulletin No. 40-20265. Defense Products Department, Caterpillar Tractor Co., Peoria, Ill.

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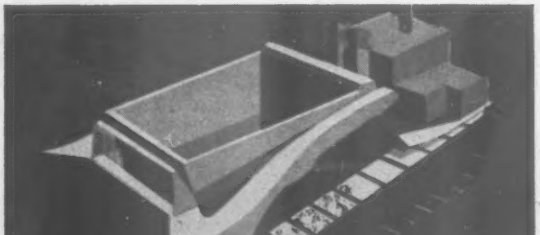
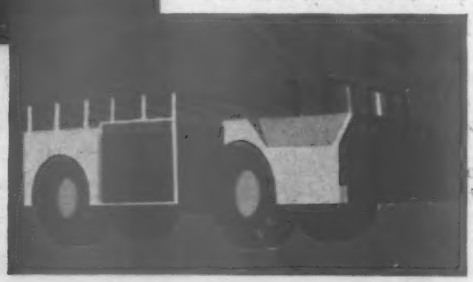


Universal Engineer Construction Machine (under development)



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RESEARCH • DEVELOPMENT • MANUFACTURING FOR DEFENSE

What Computers Are Doing In Military Personnel . . .

The Marine Corps and Strategic Air Command have begun computer operations in personnel, mainly for the purpose of getting instantaneous up-to-date information.

THE COMPUTER HAS started replacing men, but not in the sense that most people think of it today. Both the Marine Corps and the Strategic Air Command have set up programs whereby National Cash Register 304 computers will be used to tell them of their personnel needs. The computers will not reassign personnel but will tell where and what types are needed.

In less than 24 hours, both new automation systems will be able to give Marine and SAC planners a detailed picture of their manpower needs of virtually every unit throughout the world.

With the formation of the new interservice agency, Department of Defense Damage Assessment Center (DODDAC), a part of the Defense Atomic Support Agency (DASA), these systems will play an important part in helping to predict wartime personnel needs.

Personnel information from the Marine Corps computer will be fed into the main computer at DODDAC Headquarters in the Pentagon and will enable the central computer to give military planners answers to questions on personnel situations.

In peacetime the Damage Assessment Center, using the 1604 Control Data Corp. computer and the Thompson Ramo-Wooldridge display system, will be used for examining the military forces and economic resources of the U.S., our allies, and our potential enemies, to determine the hazards and vulnerabilities of such forces and resources to nuclear attack.

During war, the DODDAC would rapidly furnish an assessment of damage from nuclear attack and an inventory of a nation's remaining forces and resources available to continue.

The Marine Corps program is a nationwide computer network designed to streamline the handling of Marine Corps personnel. Under the new system, electronic service records will be maintained on about 475,000 Marines, regular and reserve, with 155 to 160 separate pieces of information about each man on less than two inches of magnetic tape. The new system will not do away altogether with the old paper form type service record but will cut down on the amount of information formerly required.

The new set-up will require outlaying posts to transmit information through regular channels into one of the three computers at either Camp LeJeune, N.C., Camp Pendleton, Calif., or Marine Headquarters at the Navy Annex in Washington.

Any one of the three installations will be able to take over the entire Marine Corps record-keeping job in the event the other two are unable to function due to enemy action or other forces.

The SAC system, located at SAC Headquarters, Omaha, Neb., will automatically report the number and type of men needed by each SAC unit. It will also locate the most eligible and qualified men for assignments and give a daily projection of SAC's manpower needs six months in advance.

When a man is needed for an assignment, the NCR 304 computer will search the files on more than 200,000 members of SAC. In less than two minutes it will consider more than 50 different facts (training, choice of duty, family status, length of service, eligibility for promotion, etc.) about every individual and select the most eligible man.

Under the new system, SAC Headquarters will receive during the night all changes in personnel status throughout the U.S. over a microwave and cable network. The network also enables information from as far away as a SAC base in Madrid, Spain, to be transmitted directly to Omaha, where the data is automatically punched into cards in less than 72 hours.

The NCR 304 computer then reads the punched cards through a 2,000-card-a-minute reader. It instantly makes the necessary changes among the more than 200,000 airmen personnel records which are contained on only five reels of magnetic tape. Annually, over a million changes must be made to the personnel file.

In addition to personnel accounting, the system will eventually provide vehicle, medical and managerial dollar accounting for SAC. ■

ANNOUNCING FROM OPERATIONS RESEARCH INCORPORATED

PERT MANAGEMENT INFORMATION PROGRAMS

A significant new management information system called PERT is being installed daily by government and industry. PERT stands for Program Evaluation and Review Technique.

■ It is a management information system that guides you in decision-making.

■ It gives you the ability to cut project time and costs providing more accurate, integrated planning information.

■ It further helps you test alternate courses of contemplated action.

Operations Research Incorporated conducts the basic PERT training programs on the East and West coasts each month. Each five-day course is limited to 20 persons and early reservations are advised.

Note the PERT course schedule on your calendar:

■ Eastern Center: Sept. 11-15

■ Chicago: Aug. 7-11 (Write Eastern Center)

■ Western Center: Aug. 21-25; Sept. 25-29

Write or call the ORI center of your choice:

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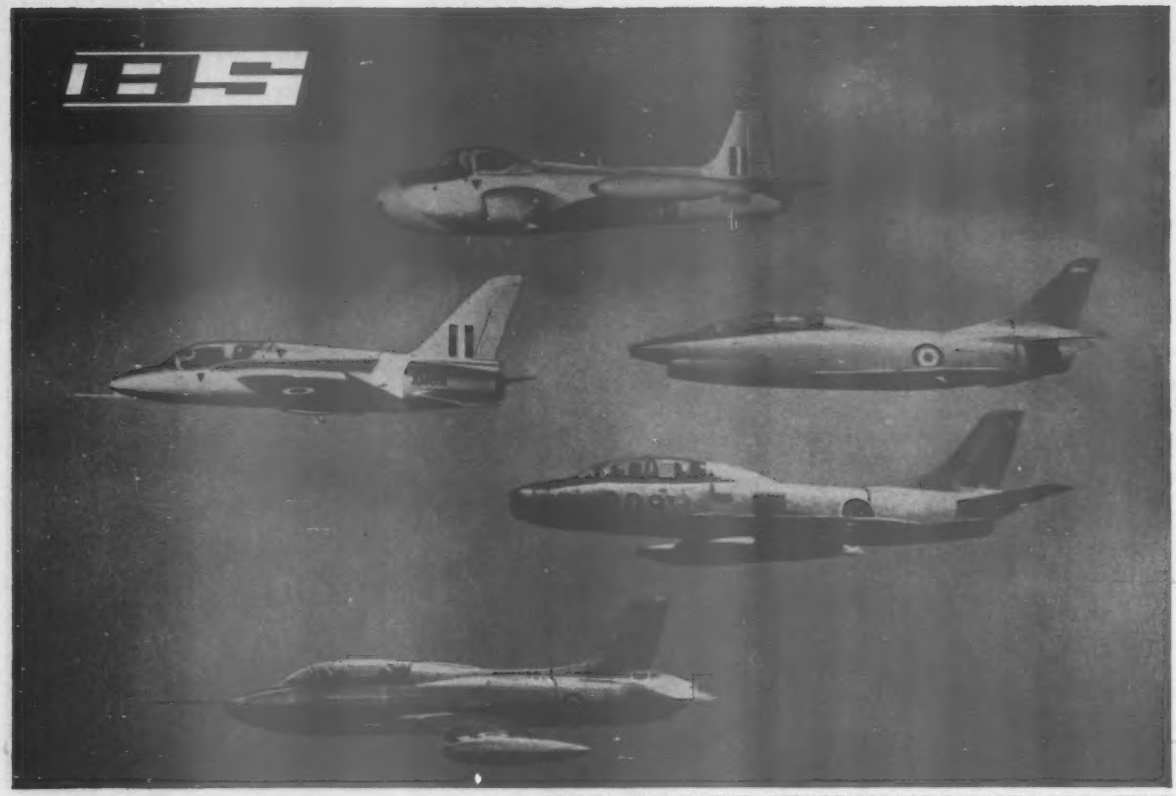


FROM L TO R: FOLLAND GNAT TRAINER—MACCHI MB 326—HUNTING JET PROVOST TRAINER—FUJI TIF2—FIAT G 91T

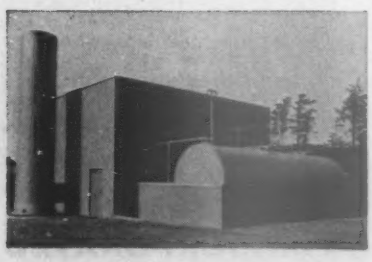
5 of the world's foremost jet trainers selected for the air forces of 5 countries . . .

. . . AND BRISTOL SIDDELEY SUPPLY THE POWER

One of the largest manufacturers of motive power units in the world, Bristol Siddeley Engines Limited produce the very successful Orpheus and Viper turbojets. These engines power many different types of production aircraft, ranging from strike fighters to target drones. Specially adapted versions of the Orpheus and Viper have been developed to meet the stringent requirements of the new generation of jet trainers, and now power 5 of the world's foremost jet training aircraft which have already been selected for the air forces of Britain, Germany, Italy, Japan and Ceylon.

Manufacturing licence agreements for the Orpheus have been signed with France, Italy, India and Germany, and for the Viper with France and Italy.

BRISTOL SIDDELEY ENGINES LIMITED

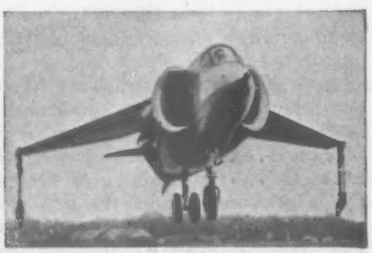


POWER FOR THIS

The Bristol Siddeley Industrial Proteus gas turbine engine powers a 3,000-kilowatt turbo-generator.

. . . AND THIS

Bristol Siddeley Maybach diesel engines power Britain's crack express train—the British Railways "Bristolian".



. . . AND THIS

The Bristol Siddeley Pegasus lift/thrust turbofan powers the Hawker P 1127 VTOL strike aircraft.

BRISTOL AERO-INDUSTRIES LIMITED, 10210 PIE IX BOULEVARD, MONTREAL NORTH, PQ, CANADA.

NATO Forecast

How U.S. May Solve NATO Dilemma

European military experts have been complaining out loud more and more of late, in effect, that "current U.S. strategy thinking is a quicksand not for us." But, adding fuel to the fire, stirring up most of the ire rampant on the continent, is U.S. treatment of European industrial base.

Kindest outline came recently from a top NATO official who said: "U.S. policy, unfortunately, is a cleft stick. Stated, and sound, official attitude is to encourage European R&D effort, strengthen our economy. Yet, your government is under pressure from industry to sell U.S. overseas. How to compromise the two is the problem."

Bright star on the horizon: reportedly one subject planned for discussion by Kennedy and DeGaulle during their recent meeting was possibility of a straight dollar purchase exchange between the two countries.

The details: France to buy $25-million in F-106 aircraft and Tartar missiles, up its support of U.S. French-based troops by $25-million. In return, U.S. would buy $25-million worth of French NorAtlas transports, using MAP funds, give the planes to underdeveloped nations like Turkey.

If idea jells, established pattern would be significant first step toward wiping out black mark record U.S. has with Europeans, the "You insist we buy from U.S.—you won't buy from us" complaint.

The Words Choked

Although ex-Air Force Chief of Staff, General Thomas D. White, had no way of knowing it might happen, European industry listeners almost choked on his comment at the recent Paris Air Show that: "It is significant to note that many of these advances (in manned orbital space flight) were possible because of complementary work among free nations. French and American aviation designers have had many successes working together.

"This unhampered exchange of information has been most rewarding. Many Free World programs, freely announced and unfettered by unnecessary screens of secrecy to shroud the shadows of possible temporary setback, continue to provide the entire world with new concepts, knowledge and practical benefits of value to all."

Reason for the gagging sound: exchange of information, whether classified or not, has long been regarded as a fiasco in practice by European firms. Among the latest weird examples: France's Nord Aviation has a "second source" contract with the U.S. Air Force for applied research on a double ramjet engine.

Yet, security rules won't permit Air Force to provide technical information clues on an above-board basis for Nord engineers to use in cranking up an intelligent effort. (Air Force is struggling currently to find some way to slide the stuff under the table.)

One ADP Problem: User Education

Much has been written on these pages about the potential savings to the U.S. and industry by using microfilm reproductions of engineering drawings, mounted in punched cards for automatic handling. But, a full year after this idea was first recognized, and some military offices (with industry help) began making the procedure routine, one problem still persists: educating top management to system's value, thereby getting their support.

Learning from U.S., European firms in the business (Rank-Xerox, Kodak, et al.) have already started the education process, even though they admit that technically they are about four years behind U.S. in equipment.

Evidence: complementary companies which provide equipment for the system got together during recent Paris Air Show, set up booths on a tandem basis so system could be followed in easy-to-grasp sequence. Second clue: Rank-Xerox particularly has done one of its heaviest selling jobs on British Armed Forces, feel if they adopt system (as they appear likely to) they will tell industry, "this it it," provide a quick solution to the "universal acceptance" headache.

ADP News Roundup

Advanced Display System Developed by Ford

An advanced electronic display system has been developed at Ford Motor Company's Aeronutronic Division in Newport Beach, Calif.

Known as Dataview, it is a family of equipment modules which form the basis of command and control system geared to the needs of military management.

Dataview provides precise, easily assimilated, up-to-the-minute visual display of data, enabling decision makers to view large volumes of varied computer output data in many diversified forms—such as line drawings, graphs, tables, special symbols, alphanumeric text, or any combination of these.

The Dataview display system permits computer-processed information to be viewed on small or large screens as multi-colored projections. Computer generated images may be projected simultaneously in different colors onto a full color map or reference background.

Two basic types of projection units are used in the Aeronutronic data processing and display system; group pojectors that provide large screen displays and smaller console projectors for use by individuals.

Group presentations are accomplished with a single projection unit, normally using the rear projection method, superimposing five images from five photographic slides onto one large viewing screen. The group projector uses a single Xenon short-arc lamp for a light source. Color presentation is obtained by passing the light through a sequence of dichroic mirrors which split the light spectrum. The mirrors produce beams of colored light of equal brightness thus allowing the projection slides to be presented on the screen in different colors.

The console projectors are completely self-contained units and are functionally identical to the group projectors. Their 15" by 20" viewing screens present background and computer generated slides, in color, randomly selected by the user from slide files.

Rear Projection Screen, a part of the Dataview System developed by Aeronutronic Division of Ford Motor Company, automatically displays computer data in color on a map background. (See story)

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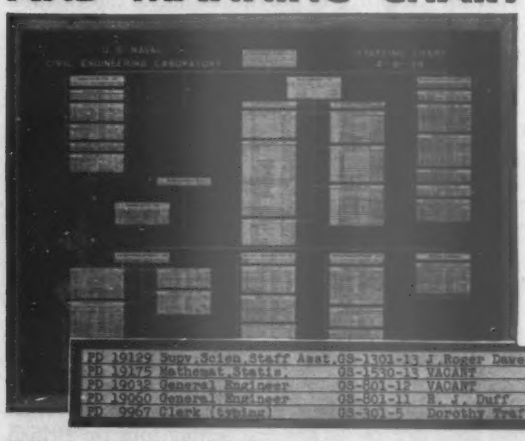

PD 19129	Supv.Scien.Staff Asst.	GS-1301-13	J. Roger Dawes
PD 19175	Mathemat.Statis.	GS-1530-13	VACANT
PD 19032	General Engineer	GS-801-12	VACANT
PD 19060	General Engineer	GS-801-11	R. J. Duff
PD 9967	Clerk (typing)	GS-301-5	Dorothy Traffalis

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MANAGEMENT CONTROL CHARTS CO.

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Low Cost Computer Developed by Monroe

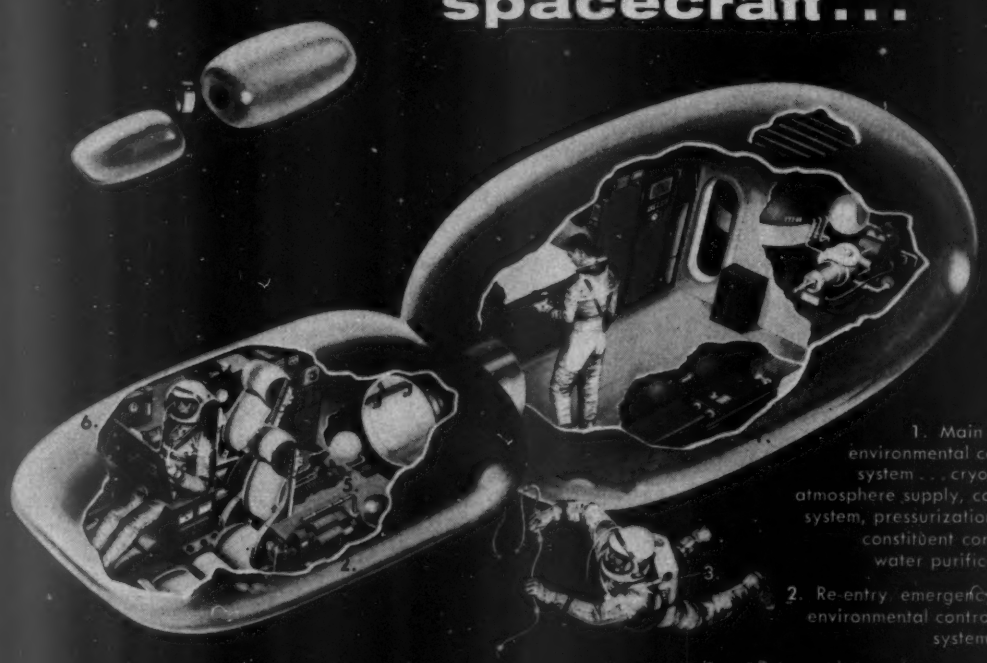
A completely automated system for labor distribution, payroll and allotment accounting has been developed by the Monroe Calculating Machine Company, Division of Litton Industries. A pilot installation is currently in use by one of Army's technical service group district commands.

The data processing system is built around Monroe's newest electronic computer, the Monrobot XI, which the company has termed "the lowest cost general purpose computer ever developed."

The Monrobot XI is a transistorized stored program alphanumeric computer, with 1,024 storage registers on a magnetic drum. Desk sized, it weighs 375 pounds, uses 850 watts on 110-volt lines and requires no special flooring or air-conditioning. Input devices may be punched tape and card readers, typewriters and teletypewriters, and numeric keyboards. The computer can output via tape and card punches, typewriters and teletypewriters. Up to three input and three output devices may be used simultaneously.

The military base accounting system includes the Monrobot XI computer with a tape reader, tape punch, card reader, card punch and two typewriters. Supplementary equipment in-

Environmental and secondary power systems for multiman spacecraft...



1. Main cabin environmental control system . . . cryogenic atmosphere supply, cooling system, pressurization and constituent controls, water purification.

2. Re-entry emergency environmental control system.

3. "Back pack" breathing and pressurization system.

4. Secondary power system . . . multiple re-entry turbine, pump, alternator and cryogenic fuel supplies.

5. Attitude control system . . . reaction motor, fuel and attitude controls.

6. Instrumentation . . . flight data and physiological monitoring systems.

Manned space flight requires reliable and efficient thermal and atmospheric systems and secondary power equipment.

Complete and integrated systems, as pictured, are being studied or under development at The Garrett Corporation. Through optimized design they offer an unmatched degree of compatibility and high performance.

Their design reflects Garrett's 20 years of leadership in developing and producing secondary power and environmental controls for aircraft and spacecraft, including NASA's Project Mercury life support system. This unique capability offers an unequaled source of research, development and production to the government and industry.

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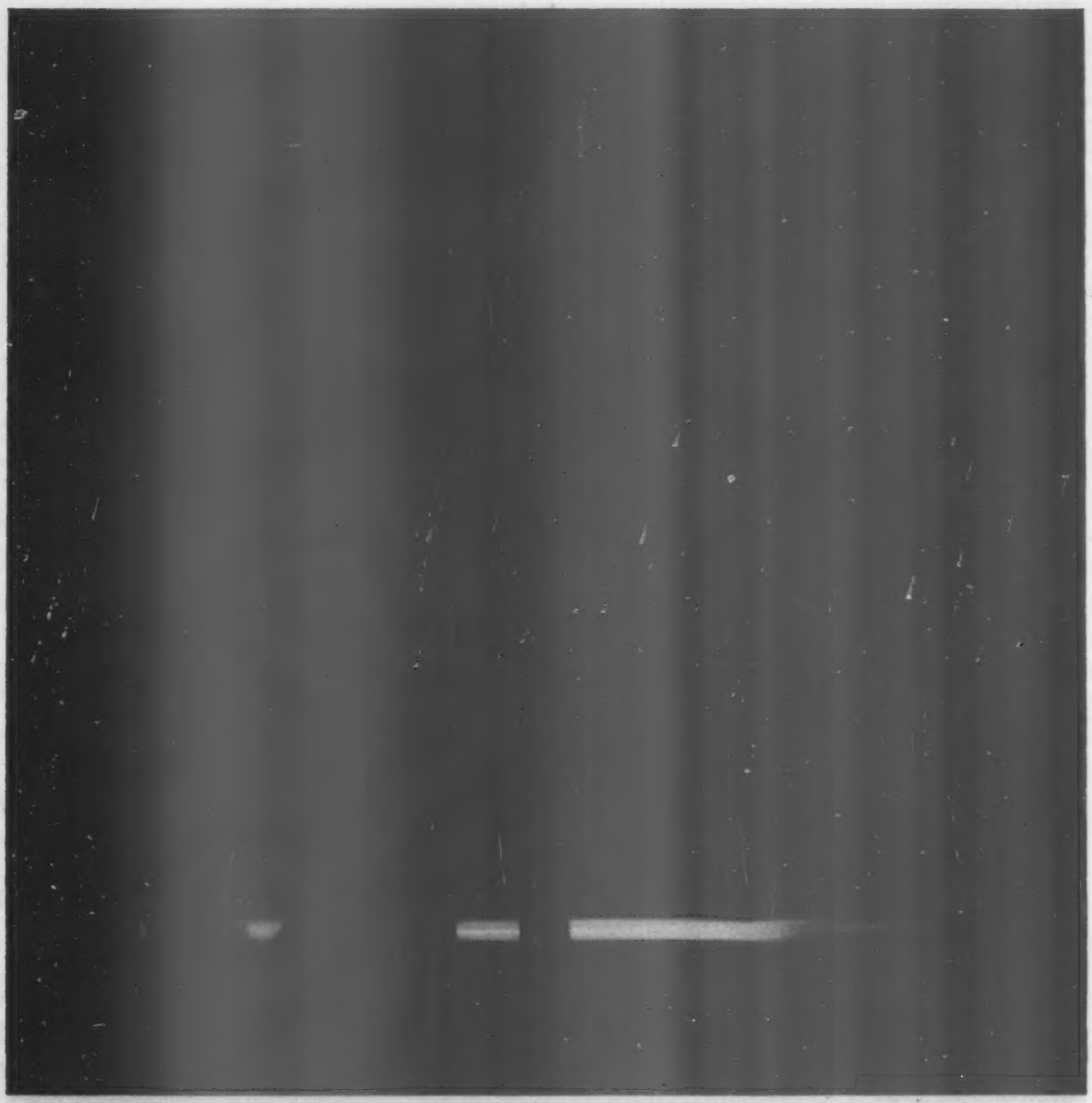


WHAT'S SO HOT ABOUT THIS 3 LB. THRUST?

It is a plasma jet, formed at more than 18,000° F., and accelerated in a magnetic field to triple its specific impulse. It is being developed in Northrop's Space Propulsion Laboratory as a propulsion system for maneuverable satelloid vehicles and spaceships. Its measured 3-pound thrust and high efficiency make it a leading candidate for the first true space drive.

In space, where gravity and friction are forgotten and acceleration time is relatively long, low-thrust, high-impulse engines like this offer a much more promising approach to space travel than most other types of propulsion. By looking at this theoretical problem from a solid, engineering point of view, Northrop bids fair to revolutionize space propulsion.

Northrop's approach to magnetogasdynamics is reflected in almost every phase of space technology. Wherever men, machines and space are coming together, Northrop techniques and experience are helping to find solid, practical answers.

NORAIR
A DIVISION OF
NORTHROP

cludes two Synchro-Monroe accounting machines coupled to IBM 026 card punches, plus one IBM 082 sorter and one IBM transfer posting device.

The complete system may be purchased outright for $55,000, or rented for $1,200 a month.

Armed Forces To Get New Mobile Equipment

The development of high-speed communications equipment, designed with the concept of field mobility to combat "brush-fire" type warfare, has been announced by Smith-Corona Marchant Inc.

The equipment, designed primarily for the Armed Forces, is manufactured by the company's Kleinschmidt Division. It includes a field data set, consisting of a teleprinter, reader and punch, and a special high-speed serial printer capable of transmitting printed tape at speeds of up to 300 words per minute.

The units can be connected with mobile field computers and will handle input and output of military logistics and tactical data.

The field data set, along with a computer, can be housed in a mobile shelter, such as a truck or trailer, so that the combat forces can actually utilize automation for strategy and tactics.

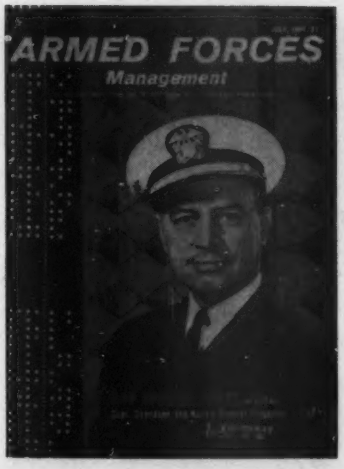
The high-speed serial printer, designated Model 6400, has solid state logic, which translates 8-channel intelligence data into 64 different alphabetical, numeric and special symbols, on 5/16 inch paper tape. The high speed of the printer precludes the need for a data storage component. This unit is designed for commercial use as well as for the military.

Westinghouse Developing Molecular Computer

A molecularized computer, one-tenth the size and weight of a transistorized computer with the same capabilities, is now under development at the Westinghouse Electric Corporation's Air Arm Division.

Dr. Patrick Conley, manager of the Air Arm Division, said that the new device, nicknamed "Mol-E-Com" for "molecular computer," will have a large number of space-age applications while providing greater payload capabilities for American rockets through the utilization of the promising new approach to electronics systems-molecular electronics.

"Unlike miniaturized circuitry, which achieves size and weight reductions through the use of smaller components," Dr. Conley said, molecular electronics makes unnecessary the familiar



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tubes, transistors, and resistors of the type found in a television set.

"In place of these components, a solid semiconductor crystal performs the same functions through the rearrangement of its internal structure to form a functional electronic block," he said. "Electronic behavior occurring within or between regions of the block gives the same effect as an electronic circuit. In the Mol-E-Com, such blocks will perform intricate electronic operations such as switching, amplification or other logic functions."

Mol-E-Com will weigh less than 15 pounds and occupy less than one third of a cubic foot instead of the 175 pounds and three cubic feet required by a similar conventional transistorized computer, he said.

Data Recording Systems Designed for Ship Use

A quarter million dollar contract for two identical high-speed Digital Data Recording Systems, designed for shipboard installation, has been awarded by U.S. Naval Research Laboratory (NRL), Washington, D.C., to Monitor Systems, Inc., Fort Washington, Pennsylvania, a subsidiary of Epsco, Incorporated, Cambridge, Massachusetts.

Each system will handle up to twenty-five inputs, ten in analog voltage form and fifteen in digital form.

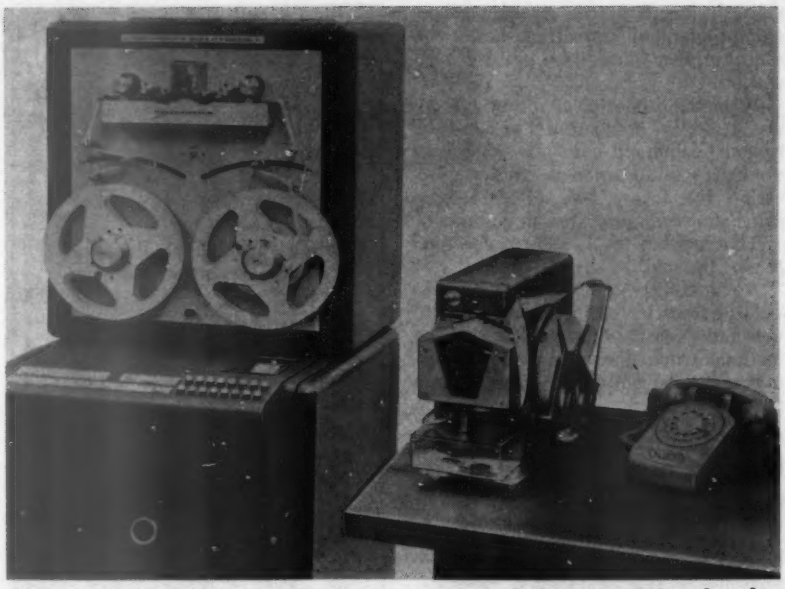
In its normal mode of operation, each system will sample all data channels within 20 milliseconds followed by a quiescent interval for the remainder of the sampling period. Frame rate can be adjusted by the operator to 0.1, 0.2, 0.5, 1, 2, 4, 8, 16, 32, or 64 seconds as desired.

The operator may select any one channel for high speed sampling at a rate of 800 samples per second. At this high sampling rate, all data is recorded on magnetic tape in compatible for IBM 650 or 704 computer processing. The magnetic tape can be played back for "quick look" recording on typewriter.

Philco Model 2400 Offered at Lower Cost

Philco Corporation has made available a new 2400 electronic data processing system, a new concept in peripheral computer design which adds 25 per cent to the time available for the Philco 2000 central computer to process computational problems.

The 2400 system, officials pointed out, lends itself to expanded processing and remains a balanced system. The added computational time for the central computer is achieved by proc-



The Digitronics Dial-o-verter System set new records by transmitting data between Chicago and Los Angeles, over the regular dial telephone network, at 1,000 words per minute, with error checking provisions to insure accuracy. (See story)

essing many routines through the 2400 which normally would be process through the Philco 2000.

The new system, which will lease for $7,800 per month, is now available for order with delivery ranging from 12 to 18 months, depending upon customer specifications.

The $7,800 per month system will include the 2400 central processor with 8,192 characters of high-speed core storage, one magnetic tape with a transfer rate of 90,000 characters per second, a card reader which reads 2,250 cards per minute, a high speed printer which prints 900 lines per minute and a card punch. The system will be used with the Philco 2000 central computer.

The 2400 system includes stored program functions sueh as editing, search and select, sorting and data translations. The basic system provides for additional input-output devices and memory expansion. Reduction of floor space, lower maintenance and power costs and fewer operator controls are other features of the Philco 2400.

Dial-O-Verter Uses Telephone Networks

Digitronics Corporation's Dial-o-verter System, operating in connection with the Bell System's Data-Phone 200 subset, makes possible the rapid transmission of punched card, paper tape, or magnetic tape data over regular toll telephone lines.

Using Dial-o-verter, as many as 27,000 alphanumeric characters can be sent during one three minute phone call. The system is equally applicable for use over private telephone lines.

Available terminal equipment of the Digitronics Dial-o-verter System includes the D505 Paper Tape Terminal, consisting of the D599SR Basic Coupler, Model D3590 Photoelectric Paper Tape Reader, and Model D5590 High-Speed Paper Tape Punch; the Model D510 Punched Card Terminal, the Model D515 Serial Card Reader, and the Model D520 Magnetic Tape Terminal. All units are based on the Model D599SR Dial-o-verter Coupler, which connects its associated terminal to the Bell System Model 200 Data-Phone subset and thence to the telephone line.

Minimum data transmission rate for any of the terminals is 100 characters per second (1000 words per minute).

USAF Awards Contract For Equipment Designs

A contract from the U.S. Air Force to study possible designs of automatic, standardized equipment for testing and checking out inertial guidance systems has been awarded to ITT Federal Laboratories.

The contract is part of the Air Force's new Project VATE (Versatile Automatic Test Equipment) which has as its objective the standardization and automation of USAF missile test equipment.

Employing inertial guidance data provided by the Air Force, the International Telephone and Telegraph Corporation division is already conducting studies of automated test equipment for guidance systems check out on Atlas, Titan, Skybolt, Hound Dog and Minuteman missiles.

Librascope Develops Space-Age Computer

Development of one of the fastest and most powerful computer systems in the world, the L-3060, was announced last month by General Precision Librascope Division.

Librascope president W. E. Bratton, said that typical configuration of the digital, multiple-computer L-3060 system will perform 2,480,000 operations per second and retrieve information from memory in less than a millionth of a second.

The transistorized system has high-speed core memory access to 144,000 words, random access to 3,250,000 words stored in magnetic disc files and magnetic tape storage files of 9,000,000 words.

The random-access information can be retrieved in 17 thousandths of a second and all files are expandable.

Bratton said the L-3060 is specifi-

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cally designed for the growing space-age problem of converting large volumes of raw data into usable information.

"Command control of rocket launching, a satellite tracking net or a central military command post," he said, "cannot exist without some medium of processing the heavy flow of data from associated communications equipment."

That is what the L-3060 is designed to do, he said.

A capability of expanding the L-3060 system by easily adding computers and other units is provided by modular trunk line organization allowing additional units to be plugged into the network.

Projection Display Aids Air Traffic

A prototype Bright Display of advanced design for use in air traffic surveillance and control has been delivered to Mitre Corporation by General Dynamics/Electronics, Information Technology Division in San Diego, Calif.

L. H. Orpin, general manager of the division, said development of the equipment marked a significant milestone in display technology, encompassing high-speed, large screen data presentations.

Named the S-C 2000 Bright Display, the electronic unit displays alphanumeric, symbolic and graphic data simultaneously with video presentations. It combines use of the CHARACTRON shaped beam tube and a completely dry printing process to provide bright, fail-safe, flicker-free displays at speeds under two seconds for each complete display, Orpin said.

The extremely high brightness and high resolution of displayed data allow it to be viewed directly on the screen of the S-C 2000 console in normal ambient light, or to be projected for group viewing on a large theatre-type screen.

The fail-safe feature of the S-C 2000 allows the last frame displayed to be retained permanently, even in the event of complete power failure.

Orpin said the console was developed under contract for the Mitre Corp., of Bedford, Mass. The company plans to use the equipment in command and control systems studies as well as for experimental programs in SATIN (Sage Air Traffic Integration) to advance air traffic control technology. Mitre, under contract with the Federal Aviation Agency and the U.S. Air Force, is studying the possible application of the Sage air defense system to serve as a combined military-civilian air surveillance and control system.

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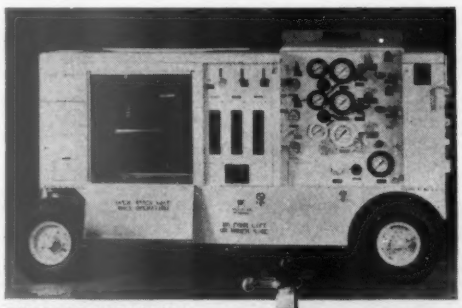

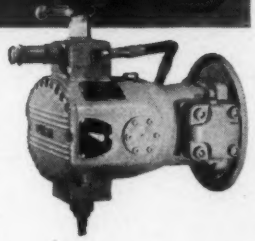

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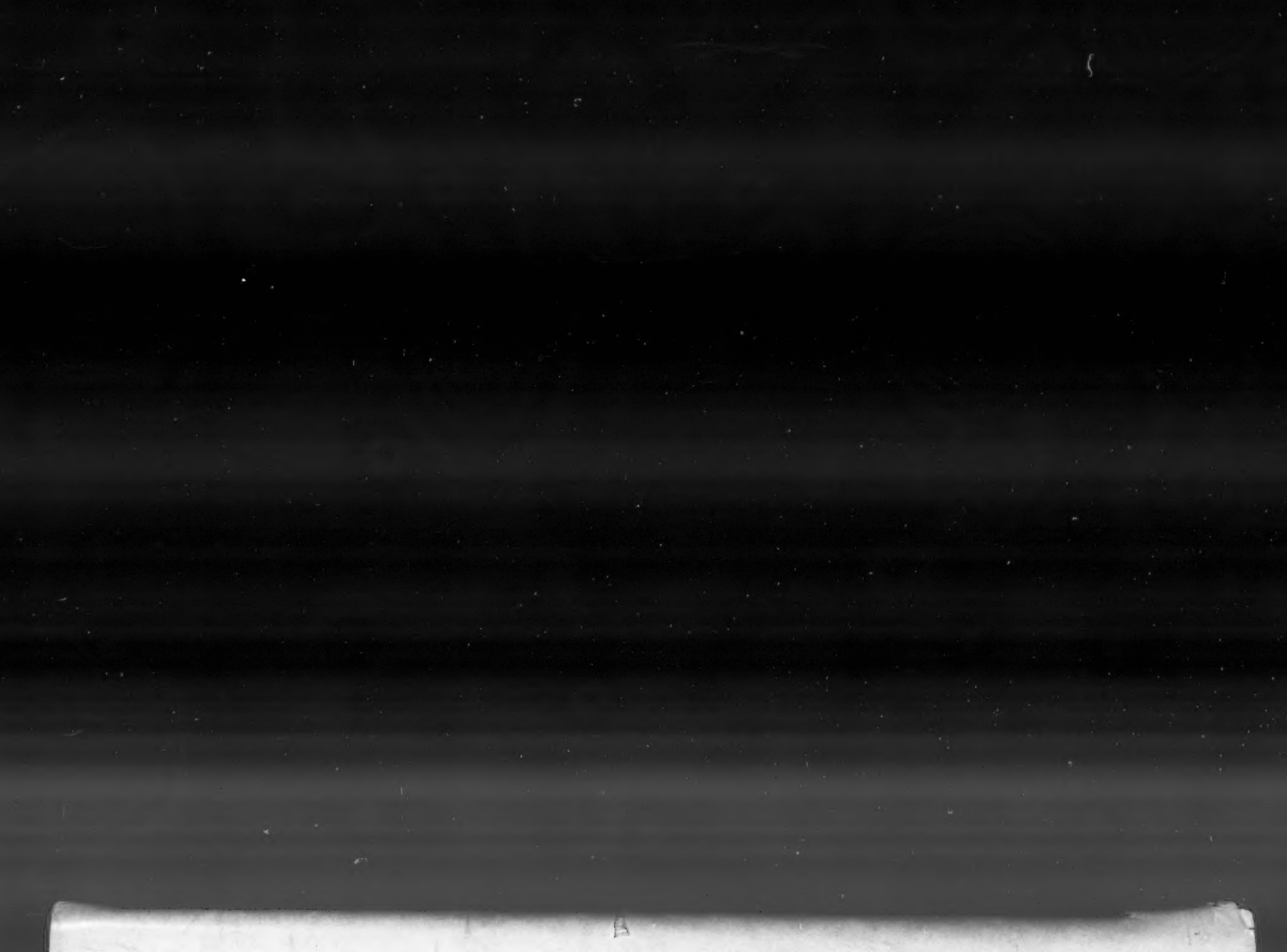
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